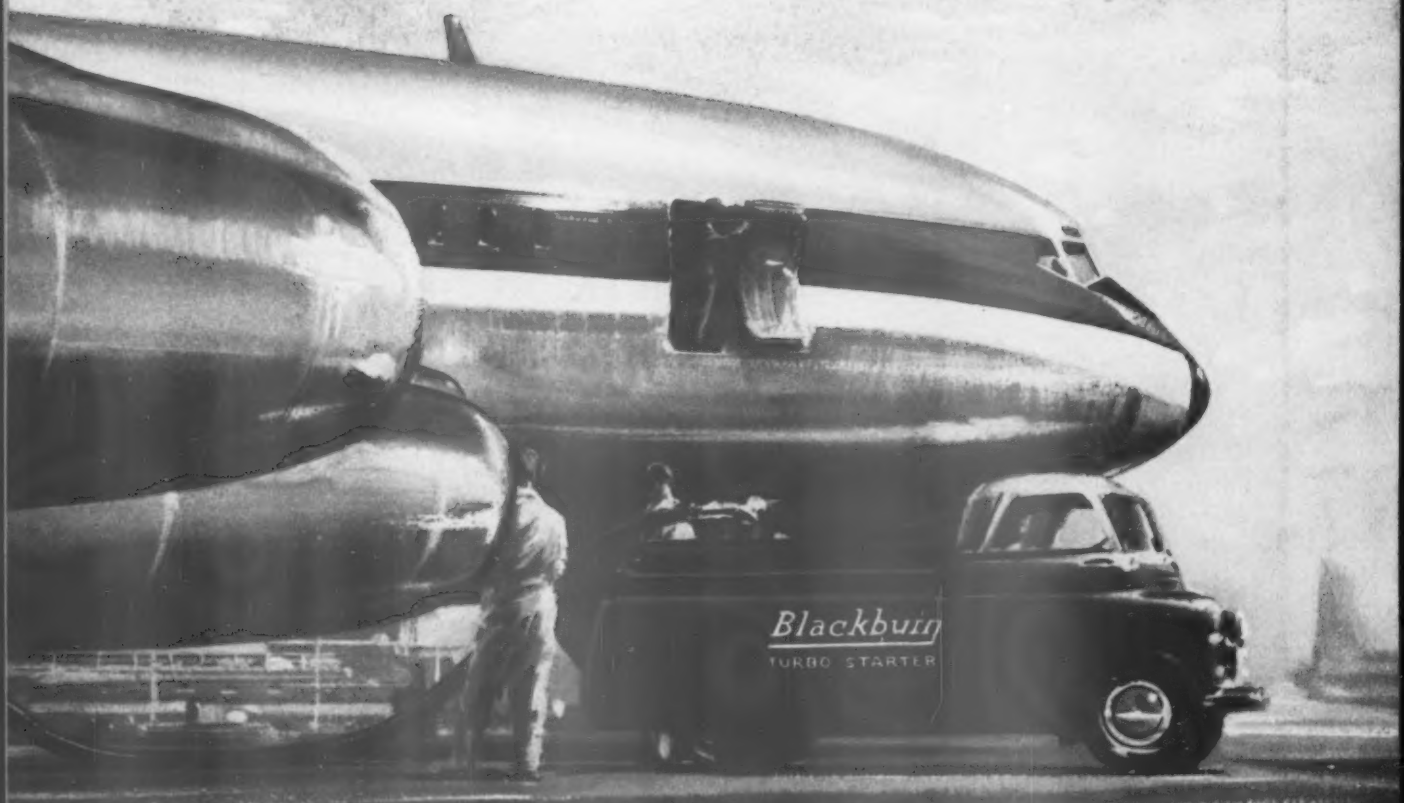
MAY 8, 1959

EVERY FRIDAY
ONE SHILLING
AND SIXPENCE

# THE AEROPLANE and ASTRONAUTICS

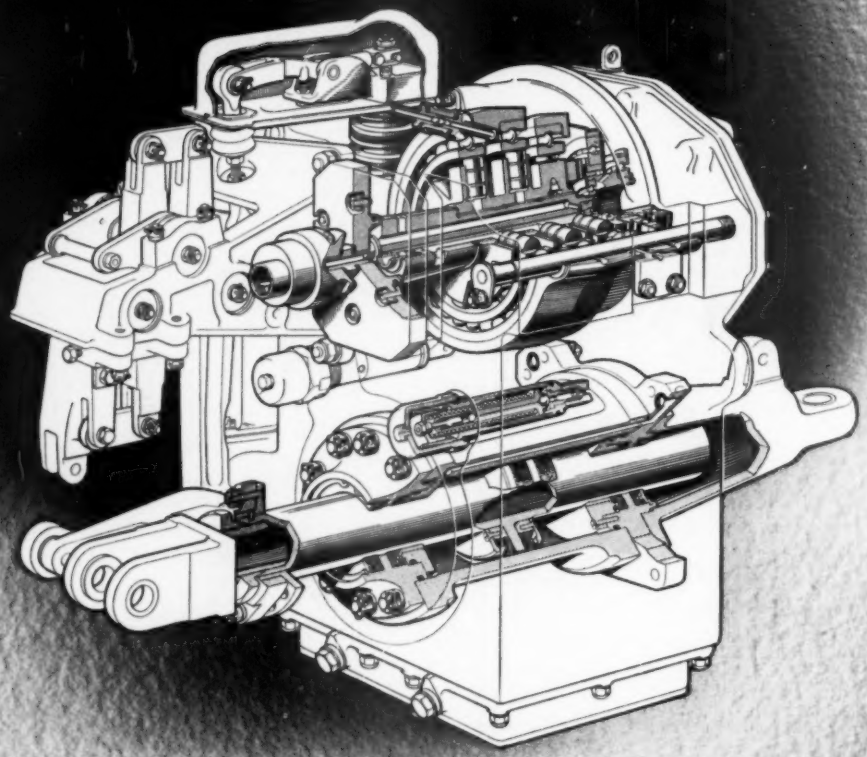



Mobile low-pressure starter for jet engines

In production for the Royal Navy, the Royal Air Force and the Royal Canadian Air Force

BLACKBURN ENGINES LIMITED, 45 BERKELEY SQUARE, LONDON, W.1

*Power Control*



Increasing numbers of modern aircraft incorporate Boulton Paul powered flying controls in their design. Why is this? Because Boulton Paul Power Controls are sensitive, accurate, stable, reliable and safe.

BPA

BOULTON PAUL AIRCRAFT LTD.
WOLVERHAMPTON ENGLAND

J.3472

# Products from SMITHS
## AVIATION DIVISION

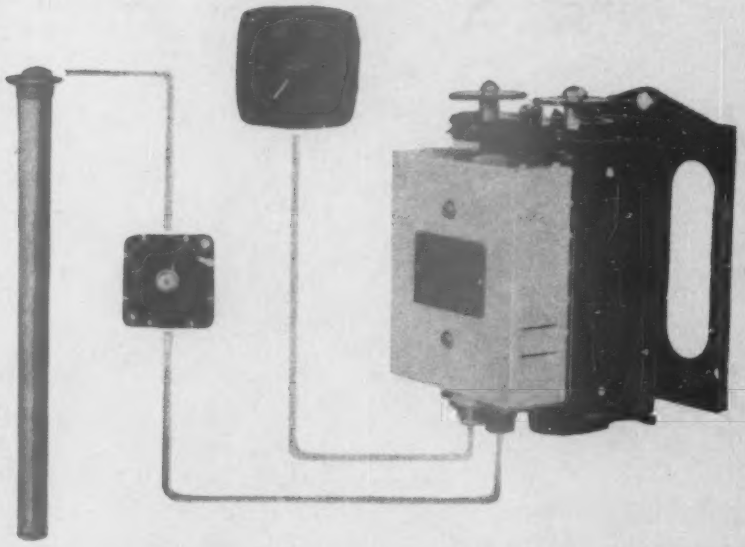
2

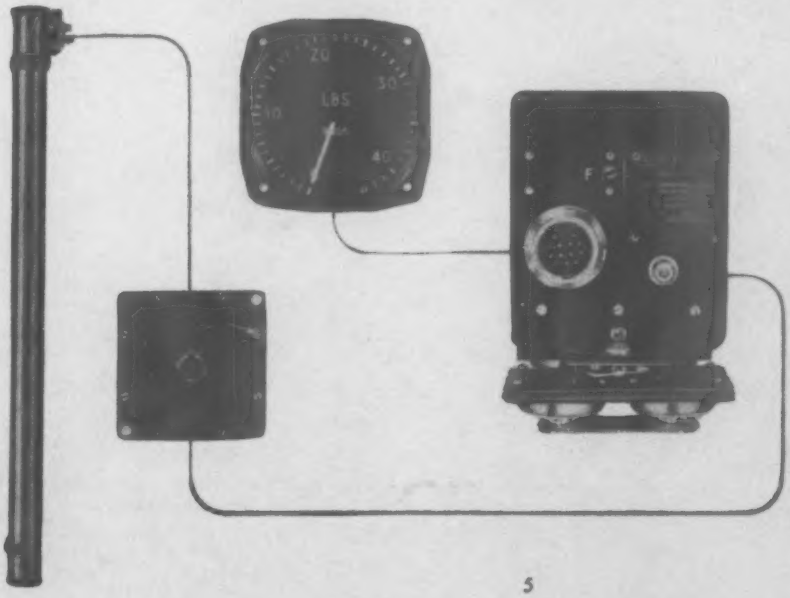
*This is the second of a series of six insets appearing in this journal during the next ten months. The next section will be appearing 10th July, 1959.*

## FUEL CONTENTS EQUIPMENT

### Smiths/Waymouth Fuel System (DI-ELECTRIC TYPE)

The Smiths Waymouth Capacitance Fuel Gauge, adopted and widely used by the industry, is to be found in all types of military, civil, fixed and rotary wing aircraft. From the initial study of constructors gauging requirements and throughout its service life, a team of specialists will ensure that the best possible standards of accuracy and reliability are obtained.

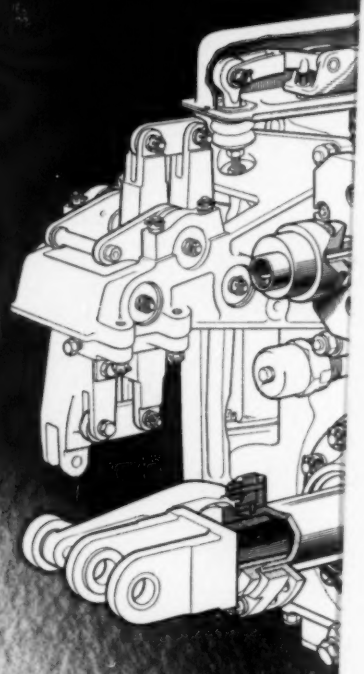





### Smiths/Waymouth Type 1 Fuel System

The Smiths Waymouth Type 1 Compensated Fuel Gauge has been introduced as an alternative system in which a method of permitivity compensation allows the principle of capacitance gauging to be extended over a wider range of aircraft fuels without impairing its high order of accuracy.

# Power Control



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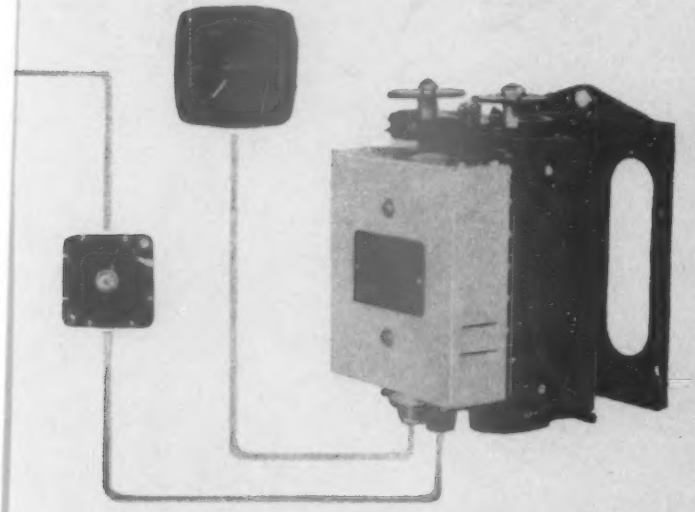

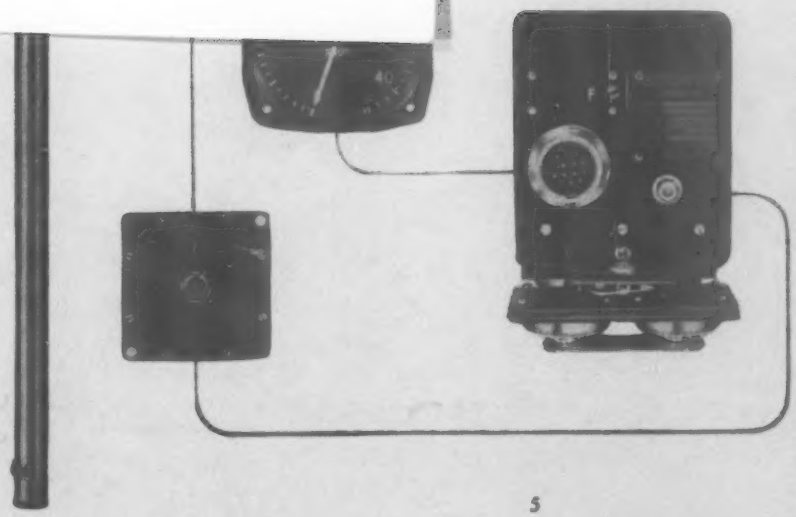

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The Smiths Waymouth Type 1 Compensated Fuel Gauge has been introduced as an alternative system in which a method of permitivity compensation allows the principle of capacitance gauging to be extended over a wider range of aircraft fuels without impairing its high order of accuracy.

## Kelvin Hughes Flight Data System

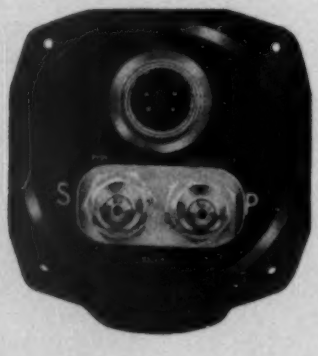
A new approach to instrument presentation. Designed in collaboration with M.O.S., R.A.E. and the Institute of Aviation Medicine. The display integrates the flight dynamic and aerodynamic information to provide I.A.S./Mach Number, altitude and vertical speed. Attitude and Navigation displays provide Compass Heading, I.L.S. Tacan or Homing range and bearing.

## Smiths Directional Gyro

Card presentation representative of a typical Gyro Magnetic Compass. Suitable for pilot familiarisation in trainer aircraft. Air driven, operates from a pressure of 3½ in. to 4½ in. Hg.

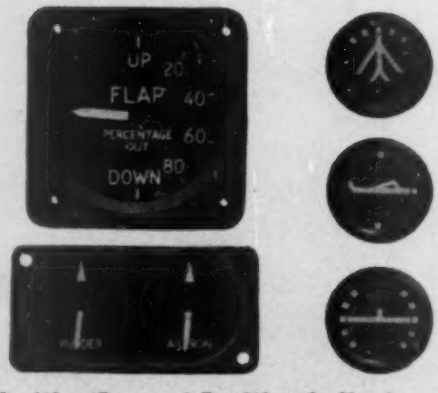
## Kelvin Hughes Machmeter

Indicates Mach number at all altitudes. Near linear scale with an adjustable lubber. Various ranges available.



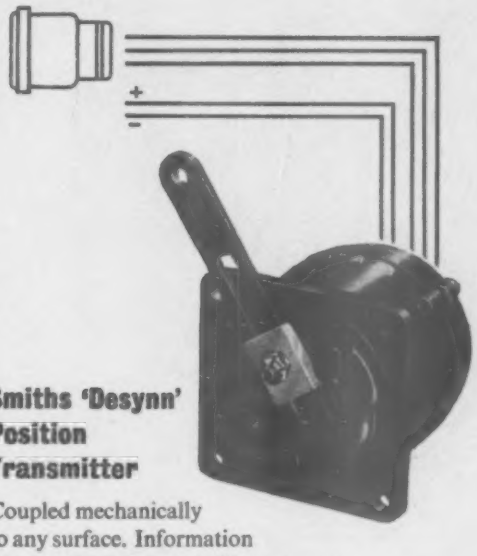

## Kelvin Hughes Mach Switch

For use when a switching operation is required at a pre-determined Mach number. Operates with extreme accuracy.



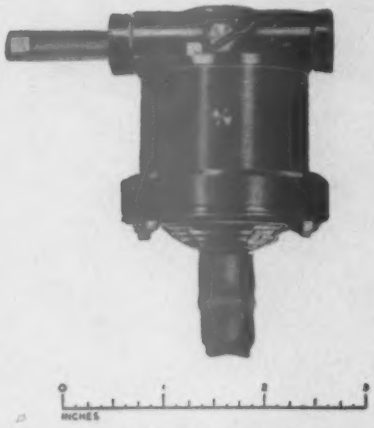

## Smiths 'Desynn' Position Indicators

The 'Desynn' system provides continuous position information and operates from a nominal 24V d.c. supply. Supplied with single movement in the small S.A.E. case. Multiple versions in large S.A.E. or 2½ in. x 1½ in. case. Miniature instruments 1 $\frac{3}{16}$ in. hermetically sealed cases.



## Smiths 'Desynn' Position Transmitter

Coupled mechanically to any surface. Information concerning movement relative to any fixed datum is transmitted electrically to the 'Desynn' indicator on the pilot's or engineer's panel.




## Smiths 'Desynn' Position Transmitter

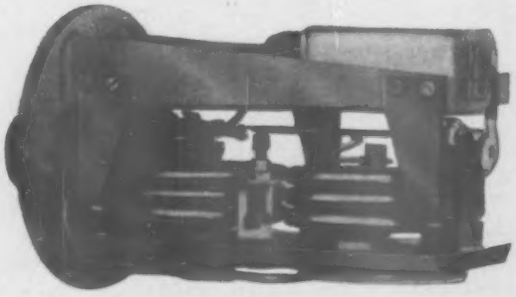
Specially designed for linear displacement requirements. Push-rod movement of approx. ·65 in. gives an indicator reading over a scale of 180°.

## Kelvin Hughes Pressure Gauge, Cabin Differential

Range 0 to +10 psi. The scale is graduated in units of 0·1 psi throughout 360°. The mechanism consists basically of a stack of pressure sensitive metal capsules and a means of magnifying their deflection.

## Smiths Rate of Climb Indicator

Available with a linear or graduated scale reading up to 4,000 ft./min. climb or descent. Capable of withstanding an overload of 60,000 ft./min. Artificially aged capsule. Fully jewelled movement. A full range of Smiths and Kelvin Hughes Rate of Climb Indicators is available.

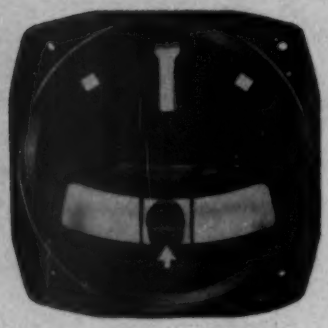


## Kelvin Hughes Stall Detector Type A

For use in conjunction with suitable warning device to indicate stall approach conditions. Can be set (as required) to operate at any p/q ratio between ·5 and 1 to a tolerance of ± ·03.

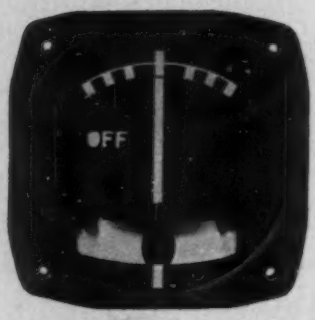
## Kelvin Hughes Stall Detector Type C

Situated on the airframe at a point where flow reversal takes place near the stall condition. The detector is in fact a snap action magnetically biased single pole rotary change-over switch. Weight 8 ozs.



**Kelvin Hughes Turn and Slip Indicator**

Air driven. Designed for use in light aircraft. Three types available for aircraft having mean speeds of 110 m.p.h., 150 m.p.h. and above 150 m.p.h.




**Kelvin Hughes Turn and Slip Indicator**

Electrically operated. Incorporates an improved method of turn pointer damping. A power failure warning flag is fitted. Fully tropicalized. Nominal 28V d.c. power supply.

**Kelvin Hughes Turn and Slip Indicator**

For aircraft with limited panel space. Operates up to an altitude of 60,000 ft. over a temperature range of + 70°C to —55°C. A warning flag is incorporated. Nominal 28V d.c. or 115V a.c. power supply. Small S.A.E. case. Weight 1 lb. 11ozs.

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Bourdon tube pressure sensitive element. Standard range 0—10 in. Hg. or calibrated 0—25 cm. Hg.

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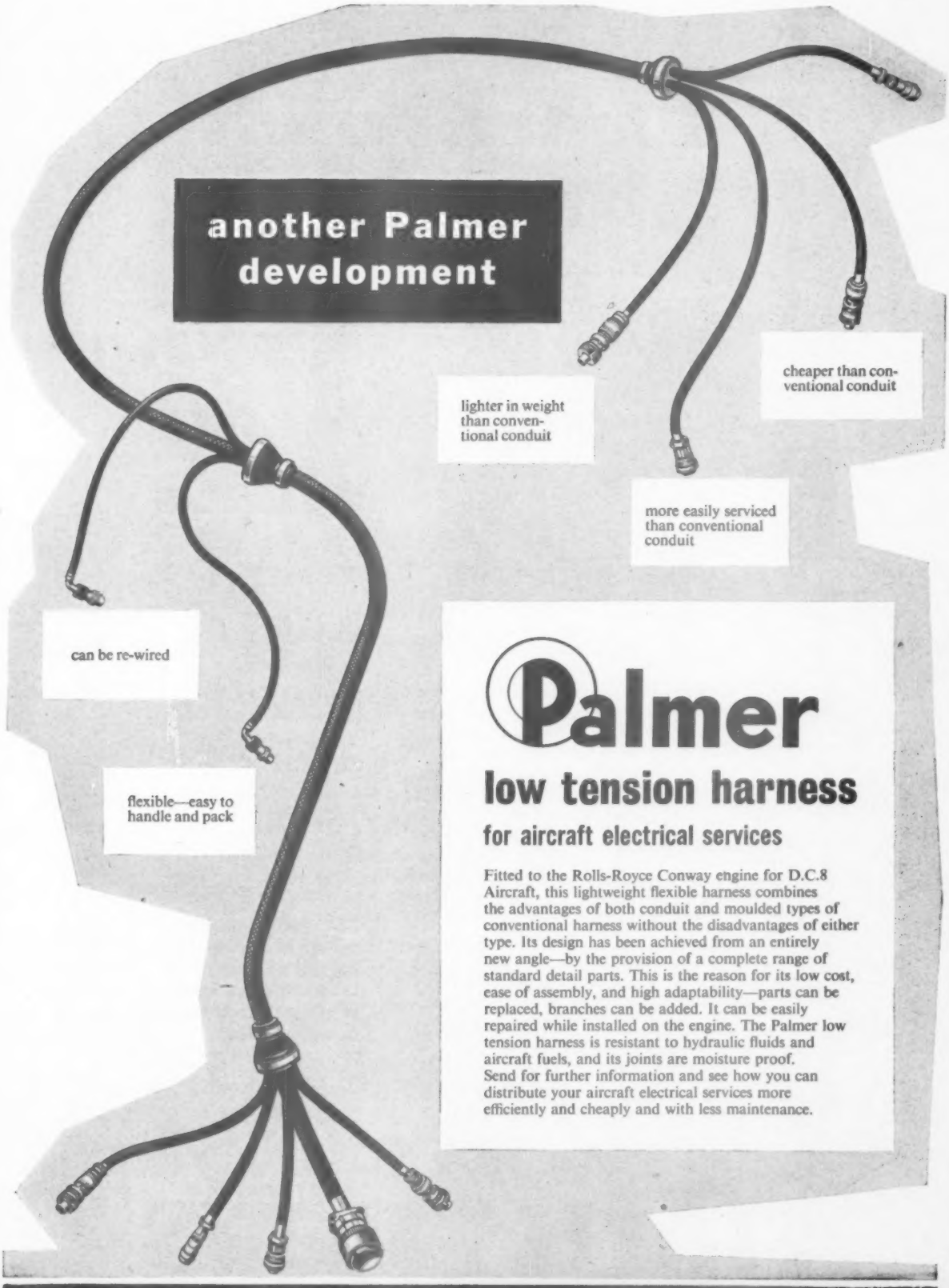

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for aircraft electrical services

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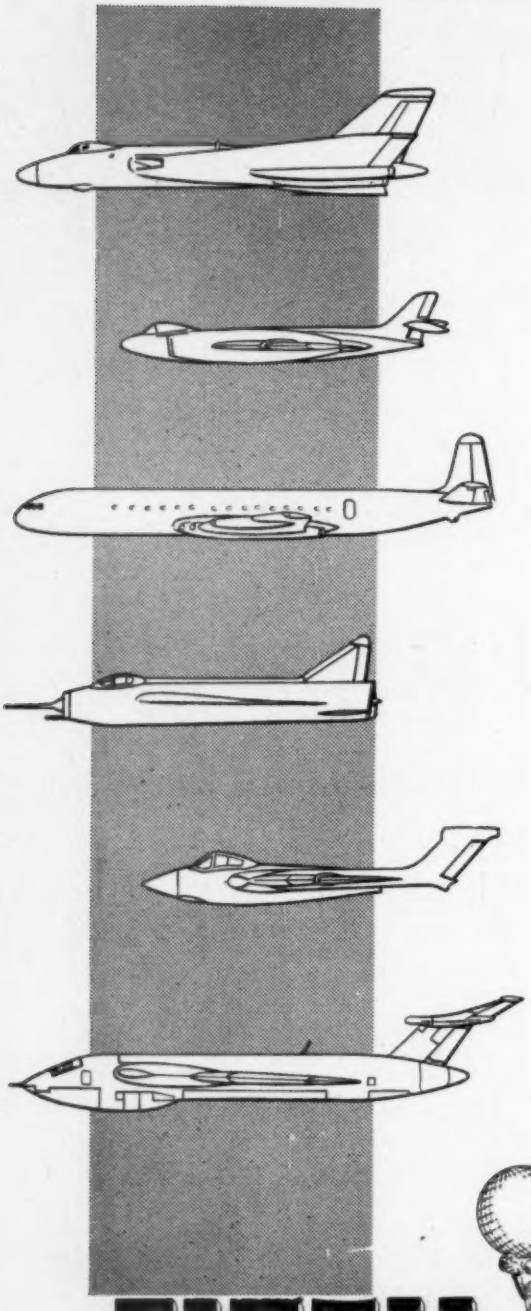

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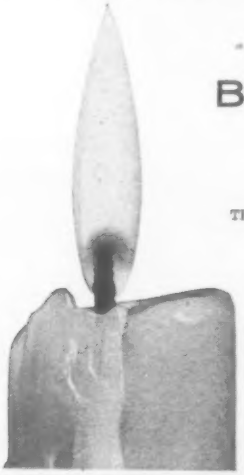

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**British Oxygen Aro Equipment combines the resources of the British Oxygen group of companies and the Aro Equipment Corporation of Ohio**

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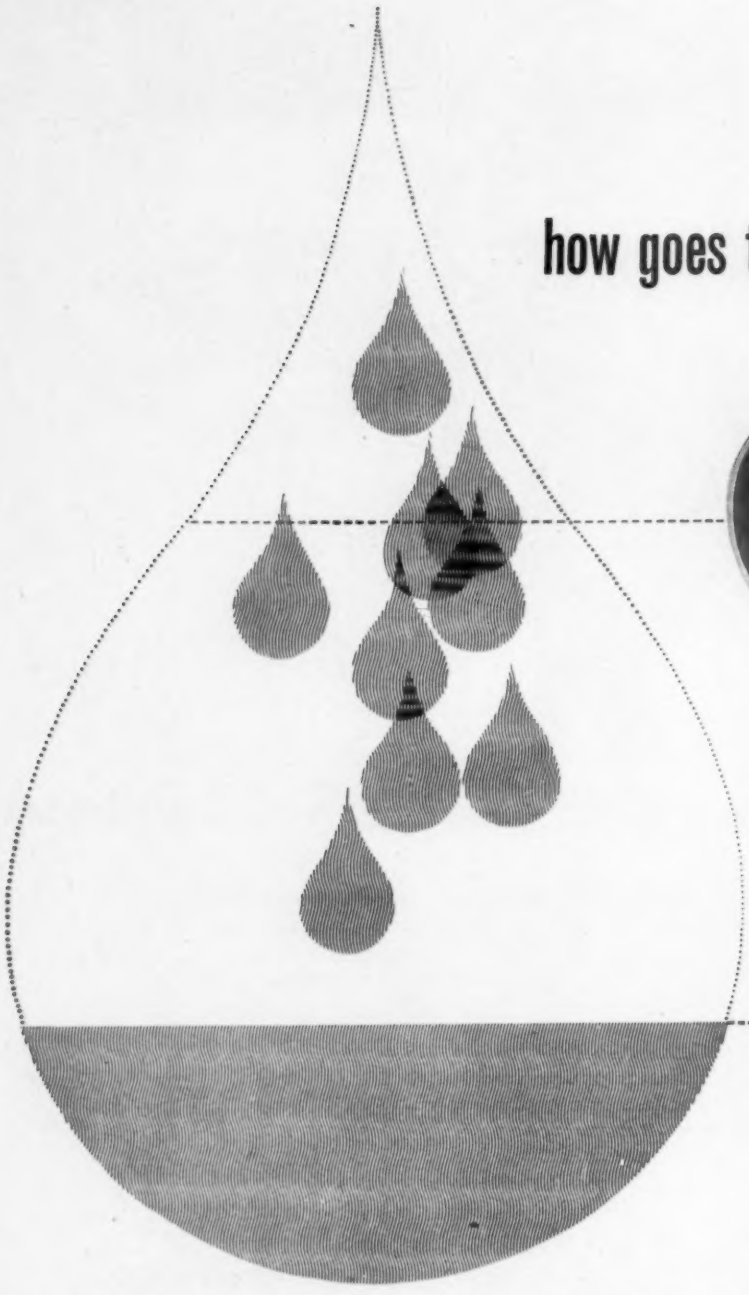

FCI FLOWMETER
A typical Transmitter Unit for flows of 200 to 8000 g.p.h.—weighs only 2¼ lbs.

PACITOR FUEL GAUGE
The combined Indicator and Oscillator unit—weighs only 1 lb. 10 ozs.

The PACITOR FUEL GAUGE shows you how much is left in the tanks—either individually or all together on one dial. These readings are independent of voltage supply, climatic conditions, or aircraft attitude over a wide range. The FCI FLOWMETER indicates the rate of flow—in units of mass or volume—as well as the amount of fuel left or gone. It is a very flexible system, allowing for a variety of single- or multi-engine installations, and all components have received M.O.S. Certificates of Technical Approval. Both these Firth Cleveland instruments are extremely light in weight, they take up little room, and minimum maintenance is required. Full details of PACITOR GAUGES and FCI FLOWMETERS from

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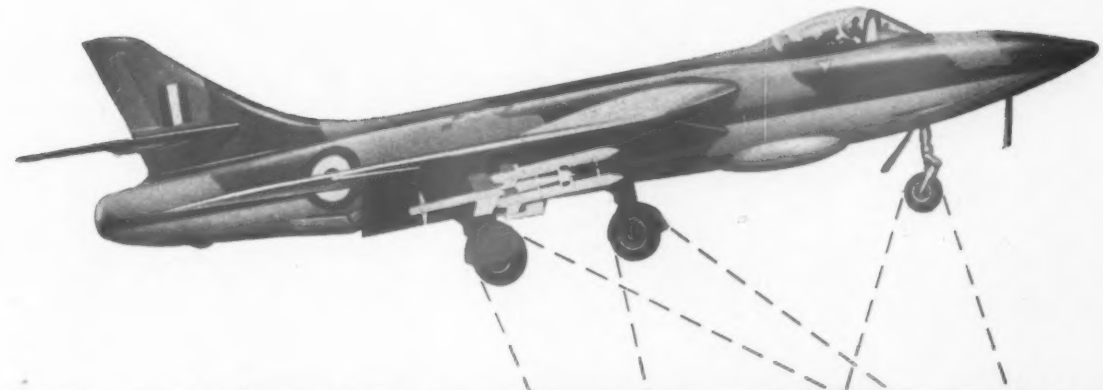

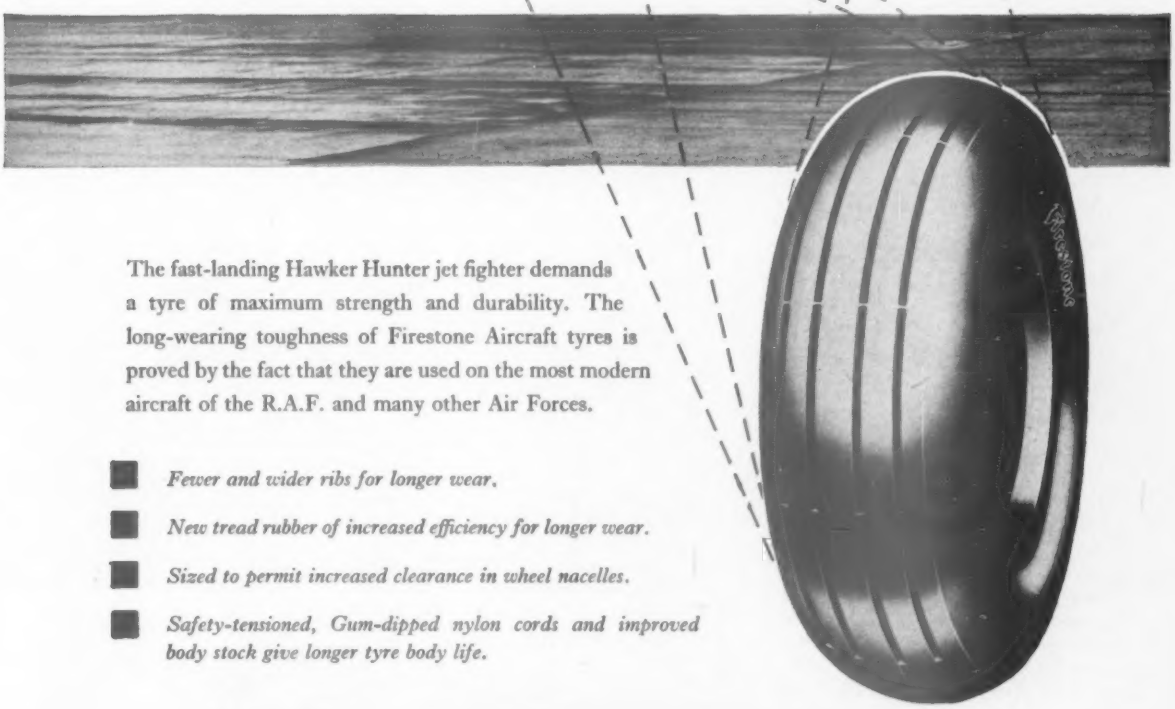

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- *Safety-tensioned, Gum-dipped nylon cords and improved body stock give longer tyre body life.*

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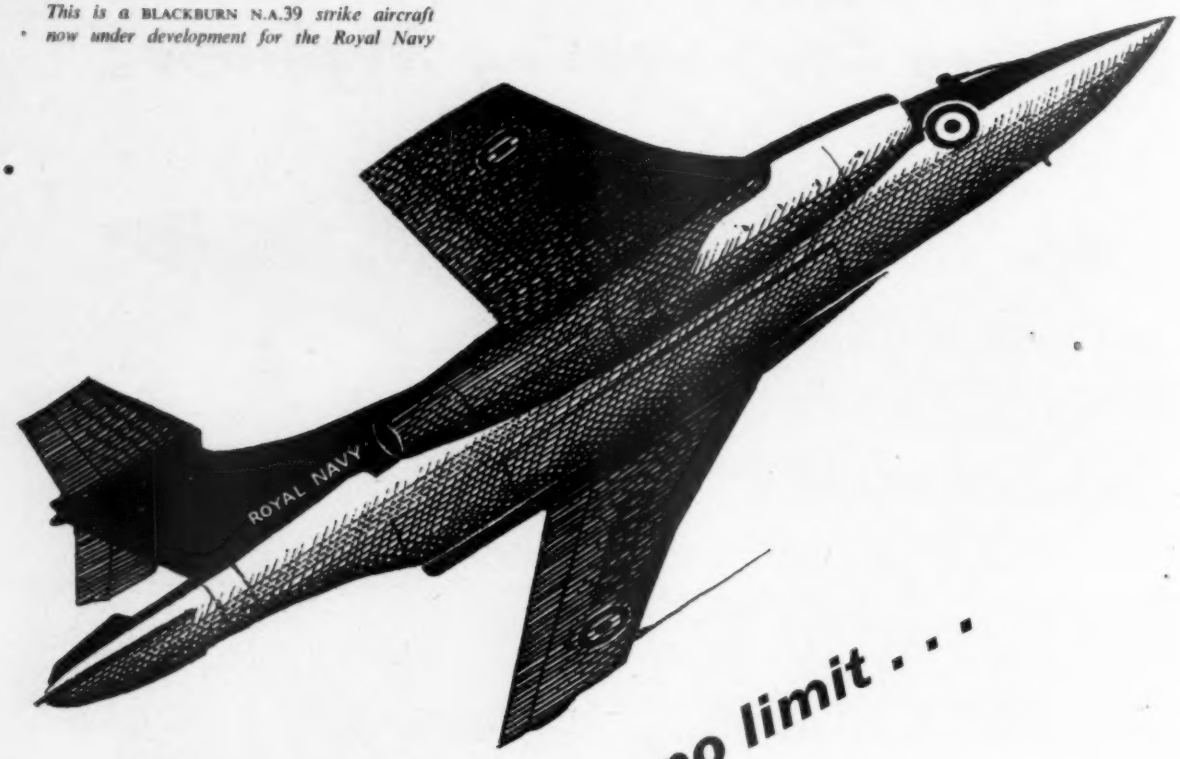
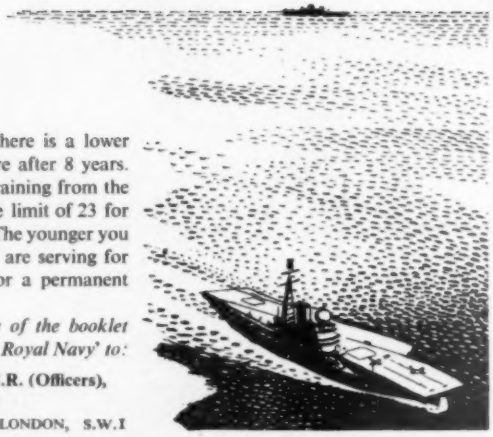
*This is a* BLACKBURN N.A.39 *strike aircraft now under development for the Royal Navy*




# The sky has no limit . . .



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## Fly as an Officer in the

# ROYAL NAVY

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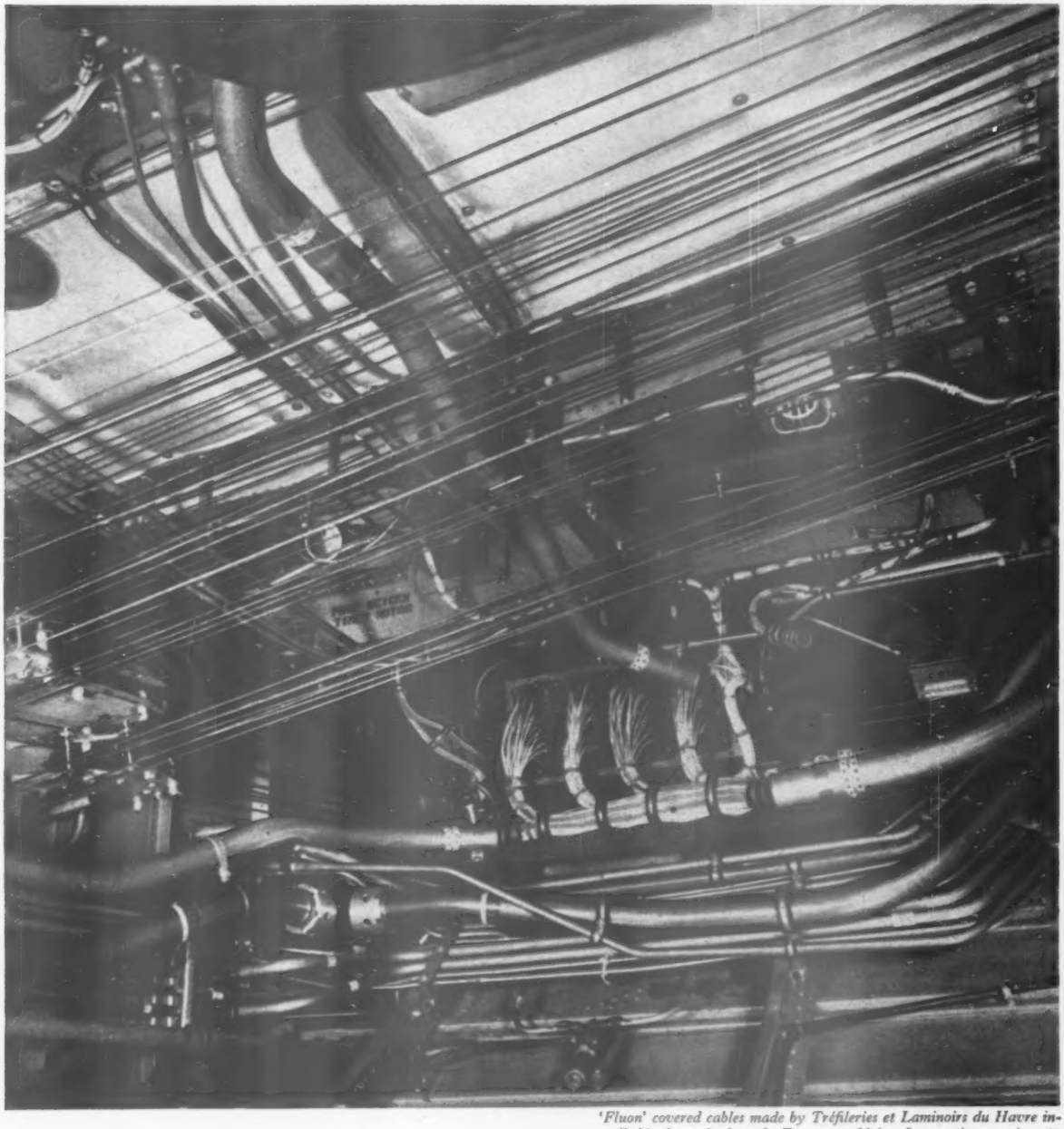

*'Fluon' covered cables made by Tréfileries et Laminoirs du Havre installed in the engine bay of a Transport Aériens Internationaux aircraft.*

# 'Fluon' covered cables in French aircraft

THE ILLUSTRATION shows cables covered with 'Fluon' p.t.f.e. and made by Tréfileries et Laminoirs du Havre, installed in the engine bay of a Transports Aériens Internationaux aircraft.

'Fluon' is proving itself an ideal material for use in aircraft. Its unique range of properties include ability to withstand frettage and vibration even at high temperatures; and resistance to corrosion and degradation from ageing over an indefinite period. It is chemically inert and has a very low permittivity and power factor, and, in addition, has a remarkable working temperature range from +250°C. down to liquid nitrogen temperature. It is tough yet flexible and has good impact strength.

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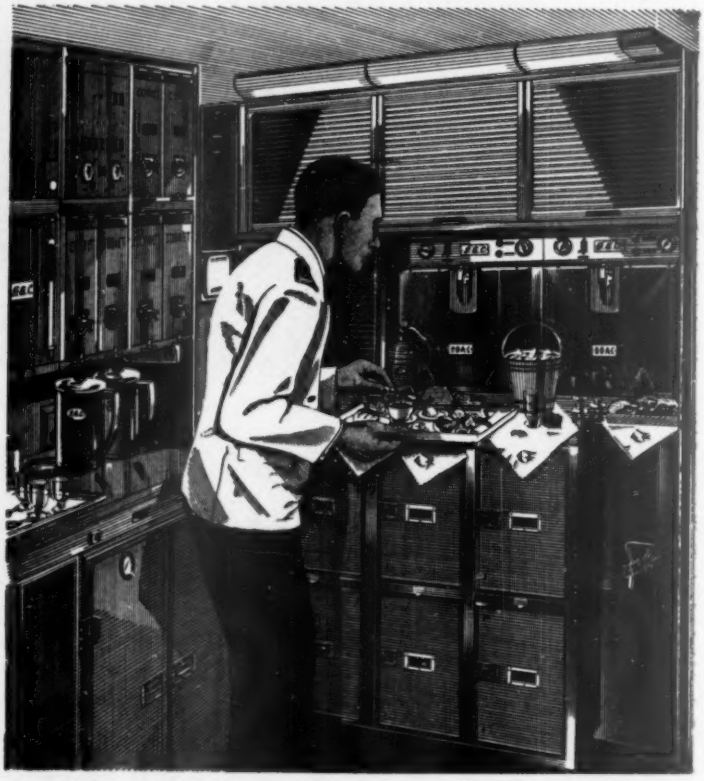

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* *Made by Elliott Brothers (London) Ltd. under licence from the Bendix Aviation Corporation, U.S.A. All parts interchangeable with Bendix American manufactured Equipment*

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## MAIN ENGINE STARTING AND CONSTANT SPEED ELECTRICAL POWER IN A SINGLE PACKAGE

THE **AIRESEARCH** CONSTANT SPEED DRIVE STARTER

is a combined constant speed generator drive and pneumatic starter which will provide turbine-powered aircraft with main engine starting and full electrical power both on the ground and in flight.

**Advantages are:**

**1.** Combines in *one* lightweight unit pneumatic starting and electrical power. Utilizes starter turbine (which is normally considered as in-flight "dead weight") for constant speed trim.

**2.** Provides full electrical power on ground without operating main engines by using a source of compressed air.

**3.** Provides full electrical power in flight with a minimum use of bleed air for speed correction. Full electrical power can be maintained on a non-operating engine by cross-bleeding air from operating engine.

**4.** The unit can be made self-contained on the ground or in the air by installing an AiResearch gas turbine into the aircraft. This closed system will fulfill the three conditions listed above.

**Other features:** Extremely light weight... low oil heat rejection... self-contained, self-cooling lubricating system... high temperature operation... constant speed output pad available for additional accessories... sizes from 20 KVA to 90 KVA.

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## From far beyond ship's horizon . . .

# Gannet A.E.W. Mk. 3

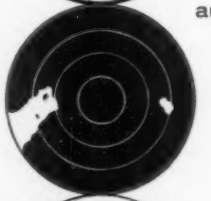
## BRINGS ALL-WEATHER WARNING

SHIP'S RADAR may see nine or ten miles; equivalent at today's airspeeds to perhaps thirty seconds flying time. Time to issue orders and train guns, with little to spare —no time to meet the attack half way. Now the Fairey Gannet A.E.W. Mk. 3 alters the naval picture. Nine or ten miles becomes 200, those few seconds become a period of vital minutes for flying-off and vectoring defending aircraft to meet the assault. The picture on the Gannet's screen is repeated by radar link in the ship, and through this link the aircraft can act as an airborne intelligence centre to direct defenders or strike aircraft. Surface and submarine vessels as well as aircraft are under its surveillance. The A.E.W. Mk. 3 Gannet multiplies the range of naval tactical intelligence at a time when the balance between air and sea power is biased against the ship.

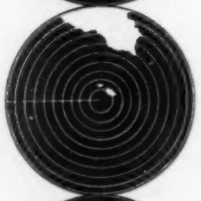
*(The Gannet is powered by a Bristol Siddeley Double Mamba engine)*

Map Area
scanned at 20,000 feet

area of ship's radar



Ship's Radar



Aircraft Radar at 5,000 feet

Aircraft Radar at 20,000 feet

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THE AEROPLANE and ASTRONAUTICS

VOLUME 96 NUMBER 2488 MAY 8, 1959

# Controversial Thor

Are the Thor IRBMs based in Britain now operational? This has been a controversial question recently, with U.S. generals saying "Yes" and British ministers saying "No." Last week the U.S. Secretary of Defense, Mr. McElroy, said that none of the Thors based in Britain was ready for immediate operational use because it had taken longer than had been expected to prepare their bases and to install the necessary ground equipment.

Is Thor a worthwhile missile? Rumours in Britain have suggested that it has considerable shortcomings. These whispers cannot be unwelcome to those who resent and fear the increasing importance of missiles, or to those who would prefer that the first strategic missiles based in Britain should be British. But do the rumours have any basis in fact? On page 552 of this issue appears an article on this IRBM based on a visit to Thor facilities in the U.S.; the background to Thor development was described in our issue for April 24.

It is impossible to discover the whole truth about a missile whose performance is secret, but some facts about Thor are indisputable. It has been test-launched more often than any other Western ballistic missile and the results show it to be reliable by missile standards. Two successful training launches with it have already been made by military crews. The missile has been designed for launching only 15 minutes after a warning is received. It is in full production. No details of its accuracy have been given, but it is said to be reasonable.

From the British viewpoint Thor obviously has some shortcomings —for example, its 1,500 n.m. range is less than is desirable and its launching from vulnerable surface sites is a drawback; Thors could in fact, be sited underground, but this would considerably increase the cost of launching sites and the time needed for their construction. But, having made the basic decision to deploy ballistic missiles, it was surely wise for Britain to adopt the Thor, which will be operational this year, rather than to wait for the more advanced Blue Streak, which is unlikely to enter operational service until 1962 or later. Thor gives Britain a ballistic deterrent some years earlier than otherwise possible, as well as giving the R.A.F. experience in missile operation which should prove invaluable when Blue Streak enters service.

# The Government and Space Research

If the space devoted to a subject in the newspapers be a measure of the public interest in it, there can be no uncertainty about the interest now being taken in astronautics, for there have been front page stories and deep headlines enough in the past fortnight and even the coining of the word "Britnik."

An impressive survey of the present situation appeared in the *Daily Telegraph* on Friday last by its political correspondent. He stated quite definitely that the Cabinet has decided, after a two-hour meeting, that Britain should embark on a space research programme on its own. The likely cost was given as between £10 million and £20 million spread over five years. The report made clear the important

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part played by Mr. Aubrey Jones, Minister of Supply, in getting the scheme under way.

However, one or two of the statements in the article seem to bear signs of some confusion. We shall be surprised, for instance, if a decision has really been taken to launch an American satellite with a Blue Streak. We should be surprised at this "compromise" even if Blue Streak were to have its first firings at Woomera this year. Actually, as we have noted elsewhere, this exciting event is more likely to take place in 1960. We believe that the first stage is much more likely to be the utilization of the proferred collaboration of the Americans under the COSPAR arrangements discussed on p. 553.

All the experience in the United States has shown that the quickest way to get results is to use developed military missiles as the launching vehicles. Consequently, it is likely to be some time before Blue Streak reaches the stage of being able to launch a British satellite. In the early stages it might be a useful compromise to launch our satellite with the aid of an American rocket.

We must not think, however, that launching satellites by rocket is the only field for activity. It may not be generally realized how long-sighted were the founder members of the British Interplanetary Society who 10 years ago had worked out many of the engineering solutions now proving their worth in the United States; the jettisonable boost motors of the Atlas running on the same fuel as the main unit are a case in point. For this reason attention is directed towards the proposals for Migrant worked out by the B.I.S. and discussed on p. 554.

Besides this Moon-probe there are such developments as the boost gliders as recently discussed in our pages. No doubt there is more than one project office in this country that would like to see their designs receiving serious analysis.

## Low-fare Flying

Another voice in favour of the development, on a national scale, of a low-cost moderate-speed mass-travel transport rather than the high-cost high-speed type, was raised in Belfast last week. Sir Matthew Slattery, chairman and managing director of Short Brothers and Harland, Ltd., speaking at a luncheon following the official leasing of Sydenham airport to his company, said that the real future of the aircraft industry lay in providing cheap air travel for the public. It lay not in going faster but in keeping costs down and bringing flying within the range of a larger cross-section of the community.

The development of a supersonic aircraft, he commented, would need something like £150 million and this would have to be borne almost entirely by the Government. Ultimately we would probably have an aeroplane capable of fantastic speed; but the number of aircraft needed would be small. He hoped that the Government would not devote all available funds to the project when the best interests of the industry for the next 10-15 years—and possibly for all time—lay in the subsonic field.

With this line of thought there will be many who sympathize. At the recent production engineers' conference at Southampton, for example, the alternatives in major future civil aircraft projects were stated clearly as speed and prestige on the one hand with economy and profit on the other. With the Government following a policy of "pursemanship" it would seem to be very much a case of: either, or. The choice of which it is to be should be a task for that Commonwealth Aviation and Space Policy Committee which many of us want to see.

One thing is quite certain, however. If the mass-travel aeroplane is really going to come to the fore as a major development alternative to the supersonic airliner, it must be something more than just a comparatively orthodox utilitarian type. Only by making it a radical step forward in air transport and incorporating, if necessary, new materials, principles and techniques structurally and aerodynamically in order to obtain something really startling in the way of operation-cost reduction, will it be a worth-while exercise in lieu of supersonics. And this sort of development will cost quite a lot of money.

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RETIRING FOUNDER.—After 39 years of service to the de Havilland Enterprise, of which he was one of the founders, Mr. W. E. Nixon is to retire on June 30; he is chairman and managing director of de Havilland Holdings; chairman of de Havilland Aircraft, of de Havilland Propellers and of the Aircraft Manufacturing Co.; and a director of other D.H. companies. He will be succeeded by Sir Aubrey Burke, O.B.E.

## Long-playing Ballistic Missiles?

Sufficiently frightening prospects are afforded by some of the latest U.S. ideas on future missile development which were revealed in recent discussions with U.S.A.F. officers. Ballistic missiles which would remain aloft for two or three days before striking their targets are being studied; they would follow high trajectories similar to those of the abortive U.S. Moon probes—themselves based on ballistic missiles—which re-entered the atmosphere some 60 hr. after they were launched.

Missiles of this sort would not suffer from some of the military shortcomings of current IRBMs and ICBMs. These ballistic missiles take less than 30 minutes to reach their target. Because of this, and particularly because they cannot be recalled or diverted, U.S. military strategy assumes that present-day ICBMs must be based on "hard" sites which can survive the first fury of any enemy attack.

Strategic Air Command, which controls both U.S. strategic missiles and bombers, considers that in future only 15 minutes' warning will be received of any enemy ballistic-missile attack. In this time one-third of its bomber strength can take off bound for enemy targets. This force can be launched when S.A.C. itself feels that it is prudent to do so, but any definite decision for it to attack the enemy can only be made by the U.S. President, who will have up to 90 minutes in which to make a decision. After this is done an irrevocable signal is sent to the airborne bombers which are already en route for enemy targets. The ballistic missiles would be launched only after a definite decision on a retaliatory attack had been made.

The new "long-playing" missiles could be launched when a situation appeared threatening and, in theory, be destroyed by command signals before re-entry if a threatened attack did not materialize. They would thus provide the decision time lacking with current ballistic missiles. Use of such missiles would seem to be carrying "brinkmanship" to its ultimate extreme; no country is likely to accept with equanimity the prospect of hostile missiles travelling high in space above it.

## Getting Tough About Noise

The Port of New York Authority has now instituted a noise-level criterion for turbojet take-offs in addition to the detailed rules for operation out of Idlewild which were laid down last year and described in THE AEROPLANE of October 17, p. 580.

The maximum permissible noise level, based on a practical measurement system developed by the Authority, is to be 112 "perceived decibels"—approximately equivalent to that experienced on the ground when the Comet 4, as an example, is at 1,200 ft. and with thrust reduced to 6,000 lb. per engine.

Nothing has been said as yet about the action which might be taken against airlines which violate the new rules, but it is obvious that the Authority means business in this matter of noise-nuisance. The new restriction follows experience in the past six months during which there have been many complaints against, in particular, American Airlines, who have apparently been fighting the restrictions by failing to comply with them.

At the end of March, according to the Authority, American had violated the rules on 107 out of a total of 343 take-offs. B.O.A.C., with the Comet 4, and Pan American and National, with 707s, have on the other hand, been praised by the Authority, as a note on p. 556 of this issue explains—so it is obviously possible to meet the P.N.Y.A. rules.

# Matters of Moment

## First-Quarter Exports

IN announcing, last week, the record quarterly export figure of £41 million worth of aeronautical goods for the first three months of 1959, the S.B.A.C. also issued a word of warning. Today's exports, said the Director of the Society, Mr. E. C. Bowyer, "are the harvest of research and development done five to 10 years ago and the need for continued Government help in these fields is of paramount importance." Mr. Bowyer went on to say that, as it is, we must expect a drop in exports which may become substantial in a year or so.

The export total of £41,035,382 for this year's first quarter exceeds that for the similar period last year by no less than 17%. It represents an annual total of £164 million compared with £154 million for 1958.

Aircraft and parts sold abroad in January-March this year amounted to £25,125,039; aero-engines £13,985,475; electrical parts and appliances £1,026,529; tyres £227,944; and instruments £670,395.

For the month of March, the export figure was £15,474,159—the second largest monthly total ever achieved. This sum was made up of £10,364,532 for aircraft and parts; £4,429,151 for aero-engines; £412,303 for electrical parts and appliances; £62,075 for tyres; and £206,098 for aeronautical instruments.

## Expansion at Shorts

FROM Belfast comes the interesting news that Short Brothers and Harland are turning their attention to the development of a general-purpose transport aircraft, the S.C.7. This is being done as a private venture and will be in the medium size category carrying a payload of 1½ tons and capable of operation from small airfields. The company say that the aircraft can be used as a passenger transport and as a carrier of all types of freight, including motorcars.

With this news has come the announcement that a new Division is being formed within the company and is to be known as the Light Aircraft Division. No details of its composition or size have been given, but presumably this has come about as a natural consequence of studying future possibilities and deciding that a small transport aircraft of the type mentioned would have a useful market.

Having come to such a conclusion, the next step would obviously be the splitting off of a section of the design and experimental teams to complete design studies and to do any initial research that would be required. It would then be logical to make this section form the nucleus of a separate division which, if all went well, could specialize in this field.

In the official statement, the new project is said to be the newly formed Division's first. This could be taken to imply that the team already has other ideas. At this stage, however, it would seem likely that it will concentrate on the one task.

No information is available on the aircraft itself. It might be expected, however, that what is clearly a utilitarian aircraft would be comparatively orthodox, both in its structure and layout. It would presumably have two engines and, because of the economic considerations of a general-purpose aircraft of this type, they are likely to be of the piston variety. If this is so, it might well be that British powerplants will not be used as the power requirements for an aeroplane of this size would seem to suggest something less powerful than is at present available.

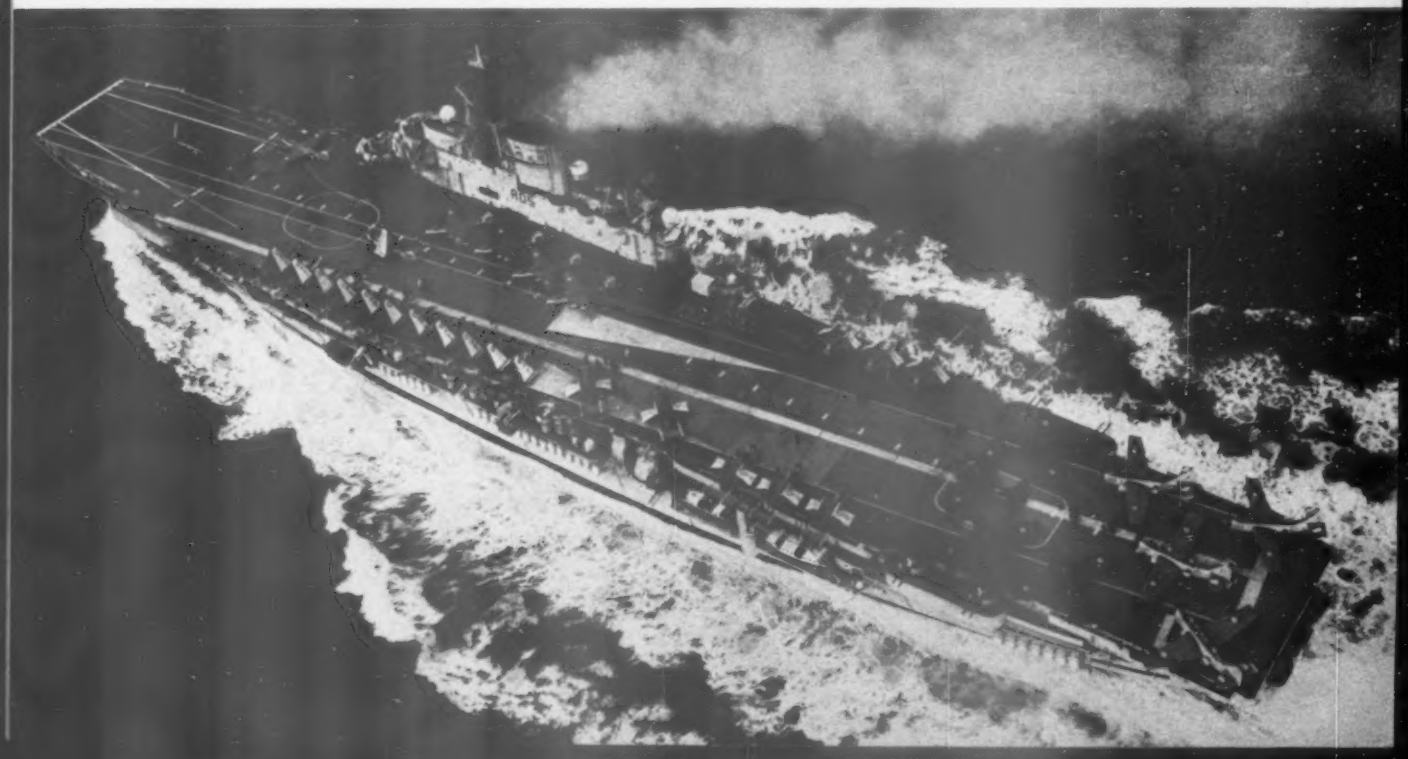
So far as general layout is concerned, a high-wing position would probably be favoured. Shorts have already indicated their preference for this in the Britannic; and in any case, a high wing results in a low fuselage with consequent ease of loading which is an important factor in an aircraft of this type. Another high-wing design in this category is the Lycoming-powered Miles HDM106.

## Biggest Gliding Championships

FROM May 9 to 18—that is, for the 10 days ending on Whit-Monday—the National Gliding Championships will be flown at Lasham airfield, situated between Alton and Basingstoke, in Hampshire. With 80 sailplanes entered, this is the biggest gliding contest in recorded history, beating both the previous contest at Lasham two years ago when 72 were entered and 70 turned up, and the German contest of 1939, with 73 entries of which 71 flew.

Saturday, May 9, is to be a practice day, enlivened with a flying display at 16.00 hr. and the official opening, performed by the Duke of Hamilton, at 17.00 hr. On Sunday, May 10, competition flying will begin, weather permitting. The weather will also influence the task-setter, Mrs. Ann Welch, in deciding each day's task, which can be for greatest distance either in any direction or along a set line; or for flying to a goal chosen by the pilot, with marks for distance along the course and a bonus for getting there; or a race over a course which can be straight, crooked, triangular, or out-and-return.

During the first week-end an International Glider Trade Fair is being held at Lasham; it will be housed in a new hangar and be open from 11.00 to 20.00 on May 9 and 10.00 to 18.00 on May 10. A great variety of ancillary equipment will be on show



BRITAIN'S LARGEST CARRIER.—H.M. The Queen, accompanied by the Prince of Wales, spent several hours at sea on April 29 on board H.M.S. "Eagle." On the deck of the carrier here are Fairey Gannets (at the stern), Douglas Skyraiders, D.H. Sea Venoms, Hawker Sea Hawks, and, in the bows, a Westland Whirlwind.

at the fair, which the B.G.A. believe is the first event of its kind in history.

Simultaneously with the main contests, those who have entered from the Services will be holding an inter-Service contest among themselves. This has been made possible by the recent formation of an Army Gliding Association, thus raising the Army to equal status with the Royal Navy and the R.A.F. which have had their Gliding and Soaring Associations for many years.

Favourites are Sgt. Andy Gough for the Air Force, Lt.-Col. Tony Deane-Drummond for the Army, and Cdr. Nicholas Goodhart or his brother Tony for the Navy. Among the civilians David Ince is a likely challenger to Philip Wills who, anyway, will be leaving before the end to take part in the Netherlands Championships which overlap ours.

All launches are by aeroplane-tow, usually to 2,000 ft. Competitors are divided into two Leagues, of which the first includes the country's leading pilots, while the second, which is the most numerous, may be given less exacting tasks than the first on some days. Nearly all the entries are of British make, mostly Skylarks and Olympias, but there are a few ancient ex-German machines, two brand-new Polish Jaskolkas, and a French Fauvette (Breguet 905) with a butterfly tail, and this machine is worth special study.—A.E.S.

## Woburn Rally Row

REPORTS in the Sunday Press about the enterprising air rally put on at the Woburn home of the Duke of Bedford on May 2 are to result in forcible representations on behalf of the Royal Aero Club.

That one Rapide pilot nosed over—the result of a piece of the cowling coming loose and jamming a landing wheel—and that some other pilots, making their first approach to an unfamiliar aerodrome in a strong crosswind, had to make one or two attempts to get down does not indicate that conditions were unsafe.

The strip in use (1,980 ft. long) runs roughly north-south and the wind came from the north-west. Between 90 and 100 aeroplanes were present, and we have yet to hear of any accidents barring that mentioned.

The Royal Aero Club was responsible for control, and has denied reports that an inquiry is to be held. One pilot to whom we spoke described the reports as " rubbish " and added, " I'd go again tomorrow if there was another show."

## Sales Week-end Well Established

WE understand from W. S. Shackleton, Ltd., whose sales week-end was held at Kidlington recently, that it was successful enough for the company already to decide to hold another one next year. That will be the third, and there is no reason why it should not become an annual event.

This sort of enterprise is always something of a gamble, but four aeroplanes were actually sold, and there are several more exceptionally good prospects for some of the new aeroplanes, many of which we illustrated in our issue of April 24.

There were nearly 70 new and second-hand aeroplanes for sale, and another 30 or so visiting aircraft arrived. Several thousands of people were present, and plans for next year's show suggest that an even larger event will result.

# Celebrating the First Flight by an Englishman

MEMBERS of the Royal Aero Club and their guests to a total of 90 gathered in the dining room of the Royal Aero Club on April 30 to celebrate the 50th anniversary of the first aeroplane flight made in the United Kingdom by the president of the R.Ae.C., Lord Brabazon, P.C., G.B.E., M.C., past president of the Royal Aeronautical Society and of the Fédération Aéronautique International. This followed a cocktail party the previous evening at Londonderry House when members applauded the tribute to Lady Brabazon made by Lord Brabazon. (Pictures of both occasions appear on p. 542.)

The distinguished company at the dinner included the present Minister of Transport and Civil Aviation, Mr. Harold Watkinson, a former Minister of Transport, Mr. Alan Lennox-Boyd, now Colonial Secretary, the president of the S.B.A.C., Sir Aubrey Burke, and the director of the Society, Mr. E. C. Bowyer. There was the president elect of the Royal Aeronautical Society, Mr. Peter Masefield, the Master of the Guild of Air Pilots and Air Navigators, Sir Frederick Tymms and many distinguished members of the aircraft industry and colleagues of Lord Brabazon on the Air Registration Board, among them Sir Frank Spencer Spriggs, Sir Roy Dobson, Sir George Edwards and Mr. J. D. North.

Pioneers were there. Claude Grahame-White, now in his eightieth year, who was given an ovation when he rose to make a brief speech, and Lt.-Col. C. J. L'Estrange Malone, to whom Lord Brabazon made special reference. Not all those present were aware, until their president told them, that the dining room of the club in which they met had been the original home of the Automobile Club when the young man of 18, later to become Lord Brabazon of Tara, had become a member.

It seemed quite fitting that the morning after the gathering the newspapers should be discussing the British Government's forthcoming announcement on its plans for the exploration of space. The reminiscences of Lord Brabazon had vividly brought to the minds of his hearers the fantastic rate of development between today's dawning era of the space age and the days, only 50 years ago, when whether one got an aeroplane off the ground or not depended on the strength of the wind and the willingness of the engine to run at all.

MR. ALAN LENNOX-BOYD surveyed the talents, achievements and gifts of Lord Brabazon, whom he described as a modern Elizabethan, in a fast-moving speech containing some delicious stories to illustrate his points. As he said, the Brabazon career would scarcely be credible to a later generation. The schoolboy at Harrow, weaned on petrol and nuts, the young Cambridge undergraduate who sent himself down after a year to go to work with the Darracq motor company in Paris. The balloonist, the pioneer pilot, the Minister of Transport, the man of affairs, the specialist on the Cresta run, the yachtsman who carried experiments with sailing rigs to such lengths as to include an autogyro rotor yet retained the affectionate regard of all who sail. He spoke of his prowess at the Royal and Ancient Game and then of his almost single-handed tackling of the unknown business of aerial photography in the First World War. He recalled his achievements in both Houses of Parliament and of the phrases still treasured there.

He had become the fourteenth Minister of Transport and though Mr. Harold Watkinson was the twentieth, there were still people who thought of Lord Brabazon as the Minister of Transport.

He spoke of his skill as chairman and recalled his presidency of the Royal Institute, of the Royal Aero Club and the Royal Aeronautical Society.

Winding up he spoke of the calmness and serenity of spirit—his generosity—lack of self-seeking and tolerance towards his fellow men.

LORD BRABAZON in his reply explained that Mr. Lennox-Boyd had proposed his health as the result of a compact made during the War. It gave him enormous pleasure to be there in the room which had been the original automobile club when he had been a member of 18. He looked on the club as his home.

He greeted his old friend Colonel L'Estrange Malone and Claude Grahame-White—" never had there been a more distinguished flyer, he had been the bravest of the brave to fly such outrageous machines." Though he, Lord Brabazon, had the first British certificate. Claude Grahame-White had got his French certificate before he did.

He then recounted the story of three significant flights. The first in Paris was in his Voisin. This was later modified and as the " Bird of Passage " appeared in the Olympic Aero Show of 1908 where it was the only machine to have got off the ground. That show persuaded the *Daily Mail* to offer a prize of £1,000 to the first Englishman to complete a circuit of half a mile. This was duly won by Lord Brabazon in a machine of Wright pattern built for him by the Short brothers. But before that he had made a chance flight at Sheppey in the " Bird of Passage " which ended in a crash and it was that flight that was being celebrated that evening.

The building of the Short machine was the birth of the English aircraft industry and in those days the manufacturers had to make everything—you could not buy even a turnbuckle.

Lord Brabazon recalled how he gave up flying at his wife's request when Charlie Rolls was killed and how he came to be a scratch player of golf, and he wound up with a tribute to the most remarkable, the most virile club in London.

After Colonel Preston had read a cablegram of congratulations from the F.A.I., Col. Gough presented the model of Lord Brabazon's Voisin, which was to show the affection and respect of far more members than could be gathered in that room.

There was special applause when MR. CLAUDE GRAHAME-WHITE got to his feet, a real old crock, as he described himself, in his 80th year, to pay tribute to one whom he had held in highest esteem all his days, and to wish him happiness, good health and long life.

# The Avro 748

## *Preliminary details of a private venture feeder-liner*

ON January 9 this year, the Hawker Siddeley Aviation Division announced that it was going ahead immediately with construction, as a private venture, of a small turboprop airliner—the Avro 748. The announcement caused considerable surprise and speculation, not least because it was difficult to see how a twin-Dart feeder-liner started now could compete effectively with other similar types already in production. Some of the Avro thinking, in this connection, was outlined in THE AEROPLANE for January 23, 1959, and a preliminary description of the aeroplane can now be given.

Two prototypes of the Avro 748 are being built, and a target first flight date has been set for February, 1960. It is intended that the new transport should be "in production and ready for the airlines" by the second half of 1961. As the illustrations here show, the Avro 748 is a conventional low-wing aeroplane, with a pressurized, circular-section fuselage and powered by two 1,600 s.h.p. Rolls-Royce Dart 514 (R.Da.6) turboprops. Typical accommodation would be for 40 passengers in four-abreast tourist-class seats, at 36-in. pitch; layouts have been prepared for mixed-class, all-freight and executive versions.

Structurally, the Avro 748 is straightforward and simple. The fail-safe philosophy has been adopted, with multiple load paths and structural joints designed to limit the spread of cracks. Zinc-bearing aluminium alloys have been avoided, and no magnesium is used; metal bonding was considered but is not used in the primary structure as it would make repairs difficult in the remoter parts of the World where the Avro 748 is expected to find a market. The majority of rivets are mushroom-headed, except on the upper surface of the wing, where flush rivets are used.

The wing is a two-spar structure with a simple integral fuel tank in each wing half. Control surfaces and flaps are all single units, and mechanical operation has been chosen in preference to hydraulic or electric actuation wherever possible. Close attention has been given to ease of inspection—no part of the structure, the designers claim, is blind—and, for ease of servicing, hydraulic, pressurization and electrical system bays have been located under the forward fuselage floor where they can be reached, if necessary, with a full load of passengers on board.

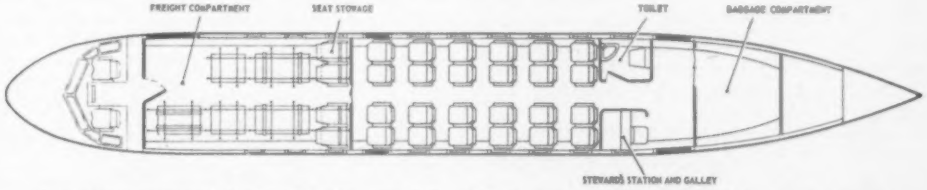
The cabin pressurization system provides a differential of 4.2 p.s.i. (8,000 ft. equivalent at 20,000 ft.); compressors for the system are driven by each engine. Two engine-driven pumps provide hydraulic power for the undercarriage, nose-wheel steering and wheel brakes. Primary electric system is 28-volt D.C., with a secondary 115-volt 3-phase 400-cycle A.C. system and a separate 200-volt 3-phase variable frequency supply for propeller and engine de-icing. Pneumatic de-icer boots will be used on wings and tail unit if required by operators.

The engines of the Avro 748 are variants of the well-proven R.Da.6, which already has a 2,000-hr. overhaul life in airline service. Friendship-type Rotol propellers will be used.

With a total fuel capacity of 1,100 Imperial gallons the Avro 748 will have a maximum range in still air, with no reserves, of 1,630 naut. miles, carrying a payload of 4,420 lb. With maximum payload of 9,666 lb. (40 passengers and freight) the no-reserve range is 580 naut. miles (equal to 190 naut. miles with S.B.A.C. reserves). Total payload over this range when operating as a stripped freighter is 10,990 lb.

Cruising at the optimum height of 20,000 ft., the Avro 748 will have a speed of 230 knots, giving a block speed of 200 knots over 500 naut. miles. Estimated costs, based on a combination of S.B.A.C. methods and actual maintenance costs for the Dart R.Da.6, show values of 69.5d. per aircraft-naut.-mile and 1.74d. per seat-naut.-mile over a 200-naut.-mile stage. The seat-mile cost is at its minimum at 400 naut. miles, when the value is 1.35d.

In I.S.A. conditions the Avro 748 will meet the climb codes of the American S.R.422A at full gross weight at airfield elevations up to 4,300 ft., and in I.S.A. +15°C., at elevations up to 2,000 ft.




One of the proposed layouts for the Avro 748, with 24 seats and a forward freight compartment.

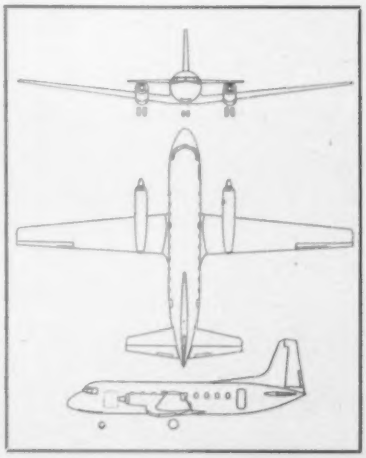
**Dimensions**
Span: 95 ft. 0 in.
Overall length: 67 ft. 0 in.
Overall height: 25 ft. 3 in.
Gross wing area: 795 sq. ft
Sweepback: Nil.
Internal cabin dimensions:
Length (ex. flight deck): 46 ft. 6 in.
Max. width: 97.2 in.
Max. height: 76.6 in.
Max. usable volume (ex. flight deck): 1,990 cu. ft.

**Accommodation**
Normal tourist: 36 (4 abreast).
Max. tourist: 44 (4 abreast).

**Powerplants**
Two Rolls-Royce R.Da.6 Dart 514.
Take-off power each (I.S.A., s.l.): 1,740 e.h.p. at 14,500 r.p.m.
Rotol c.s., f.f. four-bladed propellers, 12 ft. diameter.

**Weights and Loadings (40 pass.)**
Basic operational: 18,794 lb.
Total fuel: 8,910 lb.
Mfrs. max. payload: 11,000 lb.
Max. take-off: 33,000 lb.
Max. landing: 33,000 lb.
Wing loading (max. t-o.wt.): 41.5 lb./sq. ft.
Power loading (max. t-o.wt.): 9.5 lb./e.h.p.

**Performance**
Recommended cont. cruising speed (I.S.A.): 230 knots (at 20,000 ft.).
Balanced field lengths (S.R.422A, at max. t-o.wt.):
At I.S.A. at sea level: 3,500 ft.
At I.S.A. +15°C. at sea level: 3,800 ft.
At I.S.A. at 5,000 ft.: 4,800 ft.
Landing field length (S.R.422A at max. landing wt., I.S.A. at s.l.): 3,900 ft.
Range (take-off to landing), still air, no reserves, I.S.A., max. fuel (1,100 Imp. gal.): 1,630 naut. mi. with 4,420 lb. payload at 225 knots (mean) at 20,000 ft. (mean).
Range (take-off to landing) still air, no reserves, I.S.A., with max. payload: 580 naut. mi.



# Air Transport

## . . . And Then There Were Four

AFTER we had gone to press with last week's issue (see p. 512) it was learnt that K.L.M. had, at least temporarily, dropped out of the Europair talks, leaving Air France, Alitalia, Lufthansa and Sabena, who are due to resume discussions on May 13.

The Netherlands airline disagreed with the majority view of the group that the starting point in the integration should be agreement on the ratios of production interest for each airline in the partnership. K.L.M. felt that a thorough study should first be made of other problems—including relative spheres of influence; mutual policies; the form and measurement of authority for each partner; and arrangements for the transition period leading to any final integration.

## The Sour Note of Criticism

ADDRESSING the jet-age conference at the Las Vegas World Congress of Flight, Professor Paul W. Cherington injected, to use his own words, "a mildly sour note of criticism into these otherwise gladsome proceedings." It was, he said, becoming the exclusive province of the professor to take on the ancient rôle of court jester, saying some unpleasant things which have at least some truth in them. There was much good sense in what the professor had to say about four aspects of jet-age economics involving unresolved problems.

Marketing, "probably the most important single key to the future of airline economics," leaves much to be desired. Unless the airlines are prepared for load factors in the low 50s by 1961-62, or are willing for a return to fare-cutting such as occurred in 1948-49, much higher growth rates than the present 11% per year should be in sight. In the past year, only a handful of carriers have taken aggressive action to identify new potential markets or to re-examine their sales methods.

Ground services are of growing importance, since the length of time passengers spend in being mishandled and abused on the ground grows proportionately as air times are shortened. New thinking is required about reservations, which in the U.S.A. number 3-4 for every seat actually occupied. A reservationless service offers real possibilities for many high-density, multiple-schedule routes.

In the area of ground transportation, too, there are "many sacred cows," some of which need to be kicked. A systems approach to air transportation is needed, to integrate ground transport, ticketing, reservations, baggage-handling and other things with the air journey itself; but the airlines themselves perhaps should handle passengers only from terminal gate to terminal gate.

To be successful in the future, airlines may require to operate as larger units; the jets may make it impossible for some smaller trunk-lines to compete effectively, and the future possibility of supersonic aircraft costing $20-$30 million, plus elaborate ground handling equipment, will require large operating units. A pressure for mergers between U.S. trunklines can be expected to grow over the next few years and this movement will be aided by the ageing of top airline management: the average age of 12 trunkline chief executives today is 58 and only one is under 50.

The quality and depth of management just below the top also is of great importance—human talent as well as financial resources have to be attracted to the airlines. "The jet age is not likely to be a happy experience for carriers with a DC-3 team of executive talent."

## Airworthiness Changes

REVISED air navigation regulations* came into force on May 1, giving legal status to several new rulings, including those in the revisions to the British Civil Airworthiness Requirements which were issued in March by the Air Registration Board.

The principal changes are in the performance demanded of Group A (full transport category) aircraft, which must meet more stringent landing-distance requirements and for which there have been considerable detailed revisions of take-off and climb performance. These revised requirements have been under consideration for a number of years, but their introduction has been delayed while discussions at ICAO and with the U.S. authorities have been proceeding. These have now reached the stage at which rules could be evolved which were similar to existing U.K. requirements, but in line with draft international codes and, substantially, with the corresponding American C.A.R.s for turbine-powered aircraft.

Other changes include the prohibition for Group D aircraft (those with no specific provision for performance after power failure) of night flying and of flight when the minima at destination and departing points are less than 1,000 ft. and one mile; an increase in the number of qualifying hours for an assistant instructor from 100 to 150; and a revision in the requirements to be met by airline operators in satisfying themselves that pilots are competent to perform their duties.

*Air Navigation (General) (Fourth Amendment) Regulations, 1959. SI 1959 No. 731, price 6d., H.M.S.O.

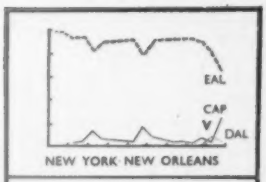
## Discussing Tomorrow's Navigation

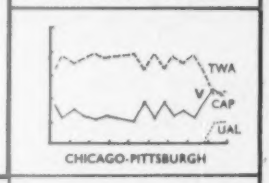
A VERY large number of papers, covering a wide variety of subjects, were read at the third joint session, in Paris, of the French, British and German navigation institutes on April 28-30. These papers will be published in full in the Journal of the (British) Institute of Navigation and for our purposes it will be enough for us to whet the appetites of the specialists by picking out a few of the more interesting new thoughts and projected new items of equipment.

(*Continued on page 541*)

**IN SERVICE.—The Ilyushin Il-18 was put into regular passenger service by Aeroflot on April 20. Among the routes now flown by this new turboprop transport is that from Moscow to Adler, a Black Sea resort on the Caucasus/Georgia border, where this picture was taken.**

# Operational success clinches the argument for the VISCOUNT



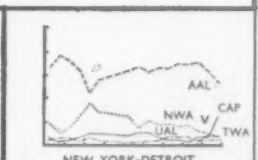



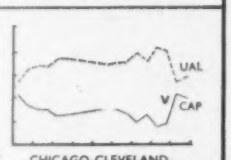

## Competitive impact of Viscount 700 a vital factor in Capital's resurgence

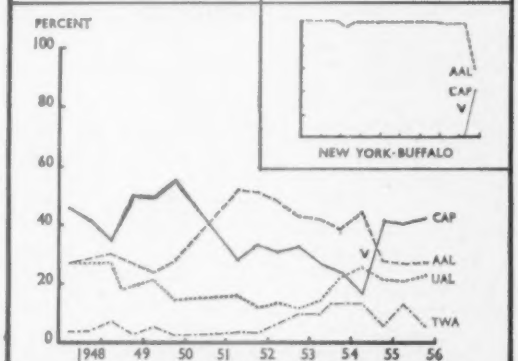
### V=Viscount Upsurge

A recent article in the American "Journal of Air Law and Commerce" (from which the adjoining graphs are reproduced), draws attention to the upsurge of Capital Airline's share of traffic following their introduction of Viscount services. The article continues, "The increase in Capital's share . . . is by no means a simple result of CAB policy. A closer look at Capital's traffic indicates that the competitive impact of the Vickers Viscount was also a vital factor. The remarkable upsurge of Capital in the 1956 section of each of these graphs follows the initiation of Viscount service. The Chicago-Washington route effectively exemplifies Capital's revival in 1955 with the initiation of Viscount services. By March, 1957, this dominance had increased from 42 to 55 per cent, while American's share dropped to 17 per cent". (V indicates period of time the Viscount was first introduced.)

Now, the Viscount 810/40 offers operators even more profitable operation than earlier Viscounts. Payload, speed and range have all been substantially increased, without raising air mile costs, giving considerably greater earning power.







## More impressive facts about the VISCOUNT 810

- **Take-off weight now 72,500 lb. (up 3,500 lb.).**
- **Landing weight, zero fuel weight and payload all increased by 2,000 lb.**
- **Maximum-payload range increased from 800 to over 1,200 miles.**
- 365 m.p.h. When re-engined with more powerful Darts, 400 m.p.h.
- Backed by Vickers/Rolls-Royce turbo-prop experience of over 300 Viscounts in service with 40 airlines.
- Viscount 810 is already in service with or on order for T.A.A., Ansett-ANA, Continental Air Lines, Hunting Clan, Lufthansa, Aer Lingus, South African Airways, Pakistan International Airlines, V.A.S.P., Airwork, Cubana, and Sudan Airways.

**CUMBERBATCH TROPHY FOR T.A.A.**

**Trans-Australia Airlines has been awarded the prized Cumberbatch Trophy for safety and reliability in Air Transport after an investigation into operation lasting over four years.**

# VICKERS VISCOUNT 810/840

FOUR ROLLS-ROYCE DART TURBO-PROP ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY ENGLAND

TGA AT618

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For their new round-the-world jet services* BOAC will rely on Shell Aviation Service—the only aviation service that circles the globe.

BOAC's Britannia and Comet airliners use AeroShell Turbine Fuel 650—the first low-freeze-point fuel to be developed and made universally available for jet and prop-jet airliners.

*Subject to U.S. Government approval.

Long flights at high altitudes result in lower final fuel temperatures. Before the new long-range high altitude airliners were built, Shell scientists examined what happens to the fuel at low temperatures throughout the entire aircraft fuel system. The findings of this work are incorporated in AeroShell Turbine Fuel 650 which has a freezing point of – 50°C and meets all the requirements of modern turbine-powered airliners.

SHELL

*you can be sure of Shell*

## *Air Transport* . . . .

(*Continued from page 540*)

Among the least well known of the future devices under development which were described at the congress is the automatic radio sextant and a paper outlining the prospects for this kind of equipment was offered by Mr. C. M. Cade of Kelvin and Hughes. Work on the principle—which follows that of the so-called radio telescope—has been going on in the U.S.A. since 1955 and Kelvin have an experimental 12-in. solar/lunar tracking telescope under development for airborne use.

Although good results can be obtained from the radio emissions of the sun and moon when their light is obscured, the difficulty is that there are few radio "stars" of sufficient "brightness" for navigational purposes and a chart of sources of such radio emission is a very strange document when compared with a normal star map. Nevertheless, there are about 3,000 localized sources ranging from the remnants of supernovae (such as the Crab Nebula) to colliding galaxies, as well as intense periodic emissions from the planets Jupiter and Venus.

Automatic optical star tracking has already been put to use in the Northrop Snark and optical or radio celestial position-fixing provides a useful correcting adjunct to inertial systems which suffer from long-term drift. In the same way inertial techniques can be usefully employed as a means of reducing the short-term inaccuracies of Doppler and this combination for civil use was discussed in a paper by Mr. A. I. Stevenson of the Sperry Gyroscope Company. The inertial technique provides an accurate measurement of speed and of the position of the true vertical.

In a paper dealing with automatic versus directly human-controlled navigation methods, Mr. A. M. A. Majendie, of Smiths Aircraft Instruments, showed how a properly tested and programmed automatic system provides, in effect, the services of a whole team of specialists for the solution of a specific task at an instant of time. The difficulty is that of formulating an inclusive operational requirement covering all possible circumstances and the importance was stressed of using operational experience in the programming of such navigation systems.

## V.C.10 Flight Control

EARLIER this year (see the issue of January 23, p. 88) we forecast that the Vickers V.C.10 turbojet transport would be equipped with a British variant of the American Bendix PB-20 automatic flight control system. It is now learnt that the Aviation Division of Elliott Brothers (London), Ltd., will supply the fully integrated dual automatic pilot, flight director and Polar Path compass systems for the 35 V.C.10s on order by B.O.A.C.

To be known as the EB-20 automatic pilot, the flight control equipment is basically the American Bendix PB-20D system which is a standard installation in the Boeing 707. The flight director and Polar Path compass systems are also similar to the units in B.O.A.C.'s 707s and it is estimated that the V.C.10 installation is 40% Elliott design and 60% Bendix. The engineering of the systems is being undertaken by the Elliott Aviation Division in collaboration with Vickers and production will be at Elliott's Rochester works.

The initial order for the V.C.10 flight control systems amounts to a value approaching £2 million. A number of the components in the EB-20 system are common to the PB-20D installation and the V.C.10 is stated to be the first aircraft to employ dual integrated systems of this type.

Polar Path-type compasses have been developed to meet the requirements for accurate directional information at extreme latitudes where the normal magnetic compasses become undependable. Containing both a flux-gate transmitter and a directional gyro transmitter, the Polar Path compass system can be supplied with three types of directional reference: from the directional gyro alone; from the directional gyro together with the flux-gate transmitter; and from the flux-gate by itself.

# European Traffic Trends

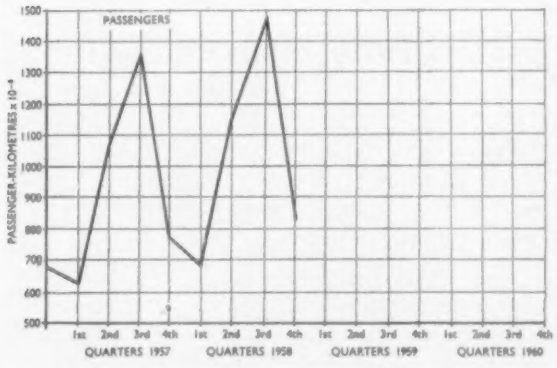
QUARTERLY figures issued by the Air Research Bureau for European traffic show that there was only a modest improvement in the fourth quarter of 1958. Compared with the same three months in 1957, passenger-miles increased by 7%; there was a 9% increase in seat-miles offered and a corresponding reduction in load factor.

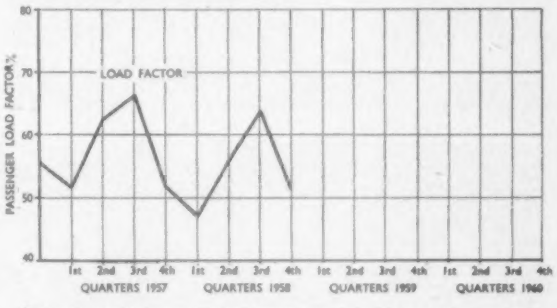
As we noted last week, European results as a whole for 1958 were not unfavourable when compared with the world-wide trend, although the rate of growth fell away quite seriously. Mail traffic reached its usual seasonal peak in this quarter and showed a high rate of increase. In the fourth quarter, the unduplicated route-kilometres covered by European operators who are members of the A.R.B. was 277,000; the network consisted of 310 stages serving 100 cities.

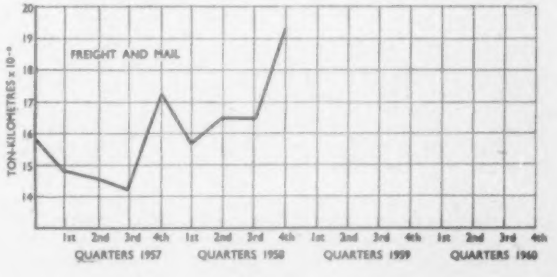
Statistics for the fourth quarter are tabulated, right, and the three graphs, which will be revised each quarter in future, show the trend of international European traffic over the past two years.

| | 4th Quarter | | 1958 as % of 1957 | 12 mths. ending | | 1958 as % of 1957 |
|---|---|---|---|---|---|---|
| | 1957 | 1958 | | Dec. 1957 | Dec. 1958 | |
| Seat/km. (million) .. | 1,497 | 1,638 | 109 | 6,422 | 7,516 | 117 |
| Pass/km. (million) .. | 773 | 830 | 107 | 3,804 | 4,144 | 109 |
| Pass. load factor % .. | 51.6 | 50.6 | — | 59.2 | 55.1 | — |
| Freight tonne/km. (mill.) | 13.5 | 15.1 | 112 | 48.5 | 53.2 | 110 |
| Mail tonne/km. (million) | 3.8 | 4.3 | 114 | 13.3 | 14.3 | 108 |

Intra-European traffic includes all traffic carried on international routes originating and terminating within the European continent and countries bordering the Mediterranean. Airlines included in this survey are: Aer Lingus, Air France, Alitalia, B.E.A., Finnair, Iberia, Icelandair, K.L.M., Lufthansa, S.A.S., Sabena and Swissair.




The graphs above and right, which will be extended and re-published each quarter in future, show the passenger, freight and mail traffic of the European carriers for the past two years.

# *In the News*

## Royal Visitor to Dunsfold

LAST week King Hussein of Jordan visited Hawker Aircraft's test airfield at Dunsfold and flew in a Hunter Trainer with Mr. Frank Bullen, the company's chief production test pilot. At the same time, Col. Othman, Chief of Staff of the Royal Jordanian Air Force, flew in another trainer with Mr. Duncan Simpson.

During his 34-min. flight, which was made in a Hunter T.66 for the Indian Air Force, King Hussein piloted the trainer for most of the trip and climbed up to 45,000 ft. before exceeding M=1. On returning to Dunsfold His Majesty said that he enjoyed the flight but it was not the first occasion on which he had flown faster than M=1, having travelled at 1,420 m.p.h. in a Lockheed F-104B Starfighter during a visit to the United States.

After remarking that "the Hunter is a beautiful aircraft," King Hussein said that the R. Jordanian A.F. already had one squadron of Hunter F.6s and is quite likely to have some more, plus some Hunter Trainers. He was received at Dunsfold by Mr. J. T. Lidbury, managing director of Hawker Aircraft, Ltd.

## Nuclear-powered Nuclear Deterrent

A NEW concept in deterrent warfare was recently described in the U.S. by Mr. F. A. Cleveland, chief advanced design engineer at the Georgia division of the Lockheed Aircraft Corporation. He was discussing the U.S.A.F. CAMAL system; the name is an abbreviation for continuously airborne missile launcher and low-level system.

In brief, the CAMAL aircraft will be nuclear-powered and remain airborne on "nomadic" patrol for upwards of a week. Should the U.S. be attacked, the CAMAL will retaliate by firing air-launched missiles at known enemy targets, and will follow this up by a high-speed low-level sortie over hostile territory. During this it will search for and attack the enemy's mobile strategic reserves whose position is not known beforehand. It will also attack hard targets which cannot be destroyed by long-range missiles.

The aircraft nuclear-propulsion programme has been supported by the U.S.A.F. and U.S. Atomic Energy Commission for more than 13 years and the total expenditure has been $850 million. Expenditure is now running at $150 million a year, most of which is devoted to propulsion. Two aircraft designs were submitted last autumn in a U.S.A.F. CAMAL competition. They were by the Convair-Fort Worth division of General Dynamics and the Georgia division of Lockheed.

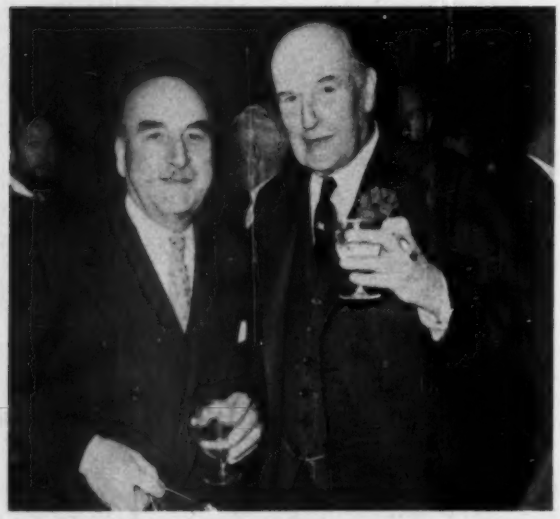
At the end of March the U.S.A.F. announced that Convair had been given the go-ahead for initial design of this aircraft, but that its construction would not begin until a successful powerplant had been developed. Lockheed was to continue only with limited design work.

The CAMAL is said to be no larger than present Strategic Air Command aircraft—in this case, presumably the B-52. But it can carry a heavier payload and operate from current S.A.C. runways. It has a virtually limitless range and endurance, although in practice it is unlikely to remain airborne for more than a week. It can be built using current techniques; the only "problem areas" are aircrew shielding and damage caused by radiation to some materials.

Full potentialities of nuclear propulsion are taken in the CAMAL low-level attack. Conventional chemically powered aircraft have a limited range at low level because of their high fuel consumption, but the nuclear-powered aircraft has no such range limitation.

The reasons given for attacking at low level are of particular interest because new British aircraft such as the NA.39 and TSR-2 will use this technique. These reasons are the reduction in radar-warning time given of an attack; the limited low-level radius of action of interceptors; the fact that radar and infra-red missile guidance is hampered by ground clutter; that nuclear warheads are unlikely to be used on defensive missiles; that the defence has an enormous data-correlation problem, as aircraft will only be observed for a very short while from a multiplicity of radar sites; and that defensive systems are geared to high-altitude attacks. These arguments certainly make a convincing case for the low-level attack.

U.S. studies indicate that more than 40 times as many radar sites are needed to protect a defence perimeter against low-flying intruders as against a high-speed high-altitude attack. Other studies have shown that with nuclear defensive missiles the attrition rate will be large if high-altitude attacks are made; there is a very much greater chance of survival with low-level attacks.



FIFTY YEARS AFTER.—As recorded elsewhere in this issue, Lord Brabazon was given a dinner by the Royal Aero Club to commemorate the 50th anniversary of his first flight. He is seen here above with Sir Alan Cobham and below, Mr. Harold Watkinson (left) and Mr. A. Lennox-Boyd. Lord and Lady Brabazon greeting guests at Londonderry House (right). Col. C. F. H. Gough, chairman of the R.Ae.C. looks on.

Shown for the first time in the standard camouflage scheme of the Allied Tactical Air Forces, Central Europe, this pre-production Fiat G.91R is one of the aircraft serving with the 103rd Tactical Lightweight Fighter Squadron (NATO).

# FIAT'S FLEXILE FIGHTER

ONE of the key concepts in the NATO strategy for a land battle in Europe is the redeployment of its tactical air power away from large permanent airstrips, into largely unprepared fields widely dispersed as a protection against nuclear attack. Coming soon after the completion of a massive £700 million infrastructure programme in Western Europe, which resulted in the construction or extension of about 150 airfields for NATO tactical squadrons, this move is slightly ironic, but following the introduction of Soviet ballistic missiles into service, it was perhaps inevitable.

It must be assumed that all the fixed military installations of NATO have been pinpointed and covered by hostile missile forces, so that the field dispersal and mobility of a powerful retaliatory air element therefore has the maximum priority. This decision was reached as long ago as 1954 by the planning staffs of SHAPE, who formulated the requirements for a tactical strike fighter for use by a number of the NATO air forces.

Another of the main considerations in framing these requirements was the need for economy in weapons development. As aircraft and operating costs are directly related to airframe weight and size, there was a clear need for a lightweight design which could be achieved within the tactical requirements of range and speed.

The lightweight strike fighter became one of the first projects of the Mutual Weapons Development Programme, which was inaugurated to make use of European design and production facilities, and reduce NATO dependence on the U.S. industry. The full background story of the M.W.D.P. leading to the formation of a permanent Advisory Committee on the NATO lightweight Tactical Strike Fighter under the chairmanship of Dr. Theodore von Kármán, was described in THE AEROPLANE of October 4, 1957, but a more detailed account of the specification for this aircraft may now be given.

An operational requirement for a tactical strike and ground-attack day fighter was issued by NATO to interested aircraft companies in Europe on March 18, 1954. There was to be a secondary emphasis on the air-to-air rôle, if this could be done without cost to the primary task. The types of targets for ground attack were defined as tanks, gun emplacements, troop concentrations, airfields, POL (petrol, oil, lubricants) stores, moving targets on the battlefield and light fixed installations.

The aircraft was also to have interdiction capability, for use against trains, barges and similar targets, and to be able to operate at low altitudes either on its own or under MSQ-1 radar direction. Its optimum performance was to be achieved between sea level and 5,000 ft., and it was to engage in air combat only in an emergency.

Operation from semi-prepared or PSP surfaces was specified, and the take-off distance to clear 50 ft. with a full warload was laid down as not more than 3,500 ft. The radius of action was to be 150 n. m. at sea level, with the ability to search for 8-10 min. in the target area. Maximum level speed was originally specified as at least $M = 0.95$, but this was not required for more than 30% of the sortie.

Its purpose was for avoiding combat, for crossing heavily defended areas and for target withdrawal, but the normal en route speed was to be 350 knots. Although an especially high-speed performance was not required, the importance of good manœuvrability was stressed, with particular emphasis on a high rate of roll. The minimum rate at sea level and a speed of $M = 0.9$ was specified as 100°/sec.

For ground attack, fixed-gun armament was proposed, with a gyro gun and rocket sight but no interception-type radar ranging or tracking. Alternative gun installations comprised four 12.7-mm. (0.5-in.) American Browning M-3 machine-guns, with 300 rounds per gun; two British ADEN cannon of 20-mm. calibre, with 200 r.p.g.; or two 30-mm. ADEN with 120 r.p.g. If more than two guns were provided, provision was to be made for firing them in pairs or together at any one time. The expended cartridge cases were also to be retained and not jettisoned during gun firing, to prevent them hitting the airframe structure.

Additional armament was to include alternatives of 12 3-in. rocket projectiles, two 500-lb. bombs, two Napalm tanks or two machine-gun or cannon pods each of about 500-lb. weight. For protection against shell fragments and small-arms fire from the ground, armour was to be provided for the pilot below and behind his seat, and the windscreen was to be armoured. Fuel tanks and lines, together with other vulnerable components, were to be in the most protected places possible.

Simple maintenance was essential, and the airframe was to be sufficiently robust for high-intensity operation from its semi-prepared fields. The major components were to be interchangeable, for repair by replacement. Engine starting was to be by the lightest and most effective internal system, with a limiting time for start-up of 30 sec. The possibility of making three successive starts was required.

With the basic armament, Government-furnished equipment would include an MSQ-1 radar responder, UHF radio and IFF radar, while a single navigational aid such as TACAN (ARN 21), DME or UHF Homing (ARA 25) would also be required. Airborne interception radar was not essential, nor was a pressure cabin, but the pilot was to be provided with a lightweight ejection seat. Another essential provision was an airbrake, to give a minimum deceleration of 0.4 *g* at 350 knots.

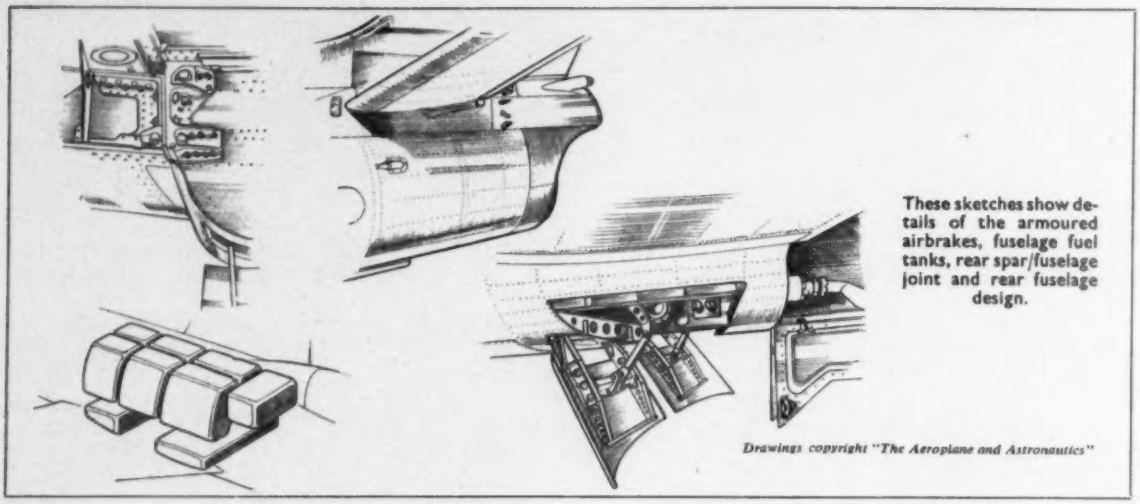
One of the most significant provisions of the specification was in the final paragraphs, which laid down that the all-up weight with normal combat load was to be less than 8,000 lb. If this could not be achieved, the increased weight was not to impose a penalty on any of the other operational requirements. A final decree was that the first 30 aircraft resulting from the specification, together with 30 spare engines, should be available during the first quarter of 1957.

### Speed in Development

Following the issue of this specification to the major countries of NATO in Europe, a time limit of only two months was laid down for the submission of preliminary design estimates and projects. Design work started at Fiat immediately after the arrival of the specification, much use being made of the company's experience with the licensed construction of the North American F-86K all-weather fighter, and a general outline of the G.91 project was submitted to an *ad hoc* committee of the NATO Advisory Group for Aeronautical Research and Development (AGARD), before the May, 1954, deadline.

In all, 10 projects from Britain, France and Italy were evaluated, and after preliminary studies, one Italian and two French designs were selected as most closely fulfilling NATO requirements, decisions which were confirmed by an independent evaluation by the U.S.A.F. With the Dassault Etendard VI and the Breguet Taon, the Fiat G.91 was awarded a development contract by the Mutual Weapons Development Programme authorities on June 3, 1955, for three prototypes, with 25% of the cost borne by the Italian and French Governments.

In the meantime detailed design of the G.91 had continued,



These sketches show details of the armoured airbrakes, fuselage fuel tanks, rear spar/fuselage joint and rear fuselage design.

*Drawings copyright "The Aeroplane and Astronautics"*

and Fiat had embarked on a large-scale tooling programme as a private venture for immediate manufacture. This proved to be an important factor in the final selection of the G.91, which soon afterwards, on July 30, 1955, received an additional NATO contract for 27 pre-production aircraft.

Development of the design was assisted by the Lightweight Strike Fighter Advisory Committee sponsored by AGARD, and the first prototype of the G.91 made its initial flight on August 9, 1956. This had grown somewhat from the originally specified weights, but soon proved that this was without detriment to the performance. The prototype was powered by a 4,050-lb. Bristol Orpheus B.Or.1 turbojet, and among the other British equipment installed in it was a Martin-Baker Mk. 4 lightweight ejection seat.

The latter proved particularly vital early in 1957 when the G.91 prototype encountered tail flutter in a high-speed run at low altitude, and the pilot, Dr. R. Bignamini, was forced to eject at about 3,000 ft. In addition to the pilot being saved, all the recording equipment was salvaged from the crashed aircraft, and an intensive modification programme was launched to remedy the flutter problem. In this the Fiat engineers were aided by French research engineers, and NACA with wind-tunnel tests at Langley, in the United States.

The second prototype G.91, powered by a 4,850-lb. B.Or.3, did not fly until July, 1957, and was still under certain restrictions when trials to determine the final selection of the NATO L.W.T.S.F. from the three projects were held at Bretigny, France, three months later. These, however, confirmed the G.91 as the original choice for the first-generation tactical strike fighter, after intensive flight trials by an international team of pilots, and this decision was officially announced in January, 1958. There were initially plans for second- and third-generation fighters to follow the G.91, but the intermediate stage appears to have been dropped, and no specification has yet been issued for the tertiary NATO design. This will probably be due in 1963-64.

In addition to the tail and engine modifications, the second prototype G.91 had a slightly raised cockpit, a ventral fin and full gun armament, and was soon joined by the third prototype. The first aircraft of the pre-production batch made its initial flight on February 20, 1958, and within a year, some 25 G.91s had been delivered to the Italian Air Force.

This had the responsibility of forming, in August, 1958, a development squadron with that number of aircraft, to prove the G.91 in intensive flying trials covering all aspects of its operational activities, and subsequently to train NATO pilots in the ground-attack rôle. The development squadron had been foreseen in the original contract as continuing its functions in parallel with the normal test-flying programme conducted from Fiat's own airfield of Caselle, at Turin, and is soon scheduled to move to W. Germany to take part in full-scale tactical trials with NATO land forces.

At the moment, it is operating as the 103rd Tactical Lightweight Fighter Squadron (NATO), based at the Italian Air Force Experimental Flight Test Centre, Pratica di Mare, near Rome. Its aircraft are operated from outlying fields with unprepared surfaces, by their Italian pilots, who have recently been joined by two Luftwaffe officers. For the tactical trials the Italian Air Force will make the aircraft available to NATO and provide a few of the pilots.

Firm orders have so far been announced for about 150 G.91s within NATO, including 50 for the Italian Air Force, 50 for the Luftwaffe, and 25 each for the Greek and Turkish air forces (under offshore procurement). The Austrian Government has placed orders for 12 fighter-bomber variants and two trainers, and interest is also being shown in G.91 procurement by the Argentine, Swiss and other air forces outside NATO. The German contract, which was signed on March 11 this year, is specifically concerned with the supply from Fiats of the G.91R tactical-reconnaissance version, but an additional agreement covers the production under licence in Germany of about 150 more G.91 fighter-bombers for the Luftwaffe by the Flugzeug-Union Sud.

The G.91R is one of several variants of the basic design which have been announced, and has a slightly modified nose housing combinations of forward-facing, vertical and oblique cameras. Normal gun armament is retained, although it is believed that the Germans will have two 30-mm. Aden cannon instead of the four 12.7-mm. machine-guns in the pre-production machines. The G.91R also operates with 100-gal. drop-tanks on its under-wing pylons, instead of offensive stores.

Orders have also been placed by the Italian Government for an initial batch of 20 G.91T two-seat advanced trainers. The G.91T has not yet flown, but is a straightforward development of the standard fighter, with an extended front fuselage to facilitate the installation of a second cockpit. Two 12.7-mm. machine-guns, with 250 r.p.g. will be provided for armament training, in conjunction with an S.F.O.M. gunsight in the front cockpit. Ultimate load factor of the G.91T is 12, and with a similar Orpheus 803 to the fighter variant, its performance will be only slightly reduced. For economy, a 4,230-lb. B.Or.4 may be installed.

One of the pre-production G.91s was modified to take several navigational systems, such as Decca and Rho-Theta, and was designated the G.91N.

Other variants of the basic design have included the G.91A, with modified wing leading edges containing integral fuel tanks of 80 Imp. gal., increasing the cruising range by 10%, and automatic slats. Its span was increased to 29 ft. 6 in., its wing area to 194.8 sq. ft., and its gross weight by 880 lb. A more advanced development is the projected G.91S, which with an Orpheus B.Or.12 developing 6,810 lb. thrust has an increase of wing sweep to 38°, and a thickness/chord ratio reduced to 8%.

### The G.91 in Detail

Both structurally and aerodynamically the G.91 is closely related to the North American F-86K Sabre, of which 231 examples were built by Fiat for the Italian (65), French (68), German (88), Norwegian (5) and Netherlands (5) air forces. In view of the limited time available for completing the preliminary design study for NATO evaluation, the value of adhering to familiar construction and design techniques was obvious. Its wisdom was amply confirmed by the selection of the G.91 as a weapons system needing relatively little development, despite competition from more sophisticated designs.

The scaling-down in such detail of a transonic fighter is an engineering feat of a considerable magnitude, particularly when restricted by the rigid and unusual requirements of the NATO specification. The aerodynamic similarity of the G.91

(*Continued on page 545*)

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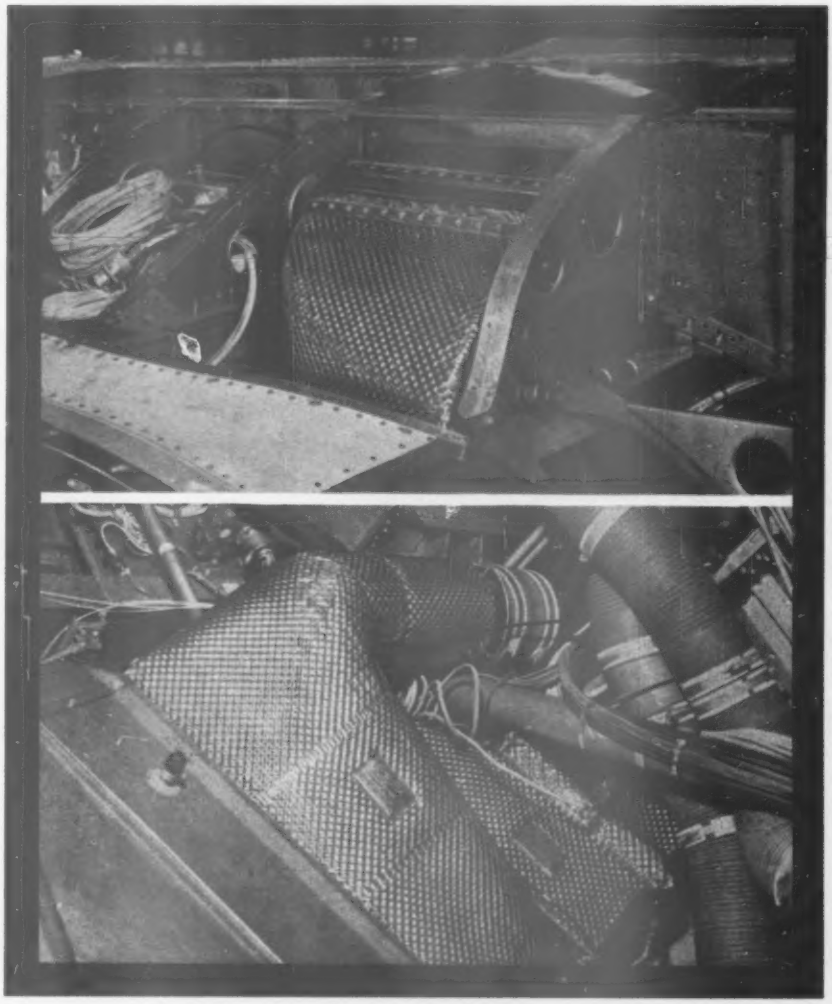

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Rare coin believed to have been struck 20 B.C. by the ancient British tribe of the Catuvellauni. Uninscribed it is probably one of the prototype coins struck after the Whaddon Chase gold coins and before the uninscribed coins of Tasciovanus, King of the Catuvellauni and father of Cunobeline, or Cymbeline, of Shakespeare's play.

When this coin recently bobbed up through the Hertfordshire subsoil, even the most learned antiquaries didn't seem to have much of a clue what it was all about. But isn't it obvious! says the M.D. Observe the obverse side, he says . . . the character in that face . . . that excellent *moustache*. Observe the reverse side, he says . . . that horse. . . that willing *little horse*. Even then our forward-looking ancestor must have been messing about with the idea. All he needed were some descendants and 1900 years' progress to get the thing properly organised. It all goes to prove, says the M.D. proudly . . . moustaches are born, not made.

Good old British

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CRC315

(*Continued from page 544*)

to the F-86K extends to such details as the installation and location of vortex generators around the rear fuselage and base of the fin, and enabled a great deal of time to be saved because of the predictable flying characteristics.

The G.91 fuselage is also of generally similar layout, a noticeable common feature being the very large gun bays on each side of the cockpit.

The centre fuselage, which is built on rotary jigs, contains the seven split fuel tanks with a total capacity of 2,750 lb. (or about 375 Imp. gal.). These are protected by armour plating at the bottom of the fuselage, and this protection is continued by the armour-clad airbrakes, which are hinged to the mainspar pick-ups and retract into the centre-fuselage.

In the after part of this section are the bays for the inward-retracting mainwheels, for which fuselage stowage is essential, in view of the fat low-pressure (50 p.s.i.) tyres for grass field operation. In keeping with the NATO aspect of the G.91, the undercarriage is manufactured by the French Messier company, and like the airbrakes, wheel brakes and flying controls, is hydraulically actuated; the flaps are electrically operated. The nosewheel retracts rearwards under the cockpit and turns on its side for stowage beneath the intake duct.

In the forward section of the fuselage, which is built separately and riveted to the centre portion, the inner walls of the gun bays on each side of the cockpit provide structural continuity. In the pre-production G.91s the gun bays are covered on each side of the cockpit by a slightly curved panel, to which are secured two 12.7-mm. (0.5-in.) Browning machine-guns and their boxes with 300 rounds of ammunition per gun.

Each gun panel weighs about 400 lb. when loaded, and is rapidly removable for replacement between sorties. Alternative installations are for fixed cannon in the gun bays, as in the case of the German G.91Rs, or for the "pop-out" stowage of 15 2.75-in. rockets on each side. The fuselage skin, forward of the gun bays, is of stainless steel for resistance to blast. As the gun muzzles are so far behind the "chin" intake for the Orpheus there are no airflow complications during firing.

The cockpit is enclosed on three sides by armour plating, on the floor and front and rear bulkheads. The front screen of the canopy is also of armoured glass, while the rear portion hinges upwards, "clamshell" fashion, with electric actuation. Although not essential, cockpit pressurization is provided in the G.91, together with air conditioning as a further aid to pilot comfort. Instrument and equipment layout in the cockpit is simple and logical, and the Martin-Baker Mk. 4 ejection seat offers both comfort and fully automatic escape, including canopy jettison, down to runway level.

Forward of the front armoured bulkhead are stowed radio and radar equipment, and oxygen for the pilot. In the tip of the nose in the basic G.91 is a gun camera, but the entire front fuselage cone is replaceable by a camera compartment for tactical reconnaissance. The nose fairing on the G.91R pivots forward for access to three cameras, in any combination of oblique, forward-facing and vertical positions. A wire recorder is also provided for the pilot to use during visual reconnaissance. Normal internal armament is retained by the G.91R, which may also carry underwing stores or drop tanks.

In common with the F-86K, the G.91 has a detachable rear fuselage, with a four-bolt pick-up for access to the Bristol Orpheus turbojet. Although the Orpheus was not directly specified by NATO for the L.W.T.S.F., it was selected by Fiat's as the best available powerplant on a power/weight basis, and on its development potential. It performs excellently at low altitude, which is naturally important in the G.91, and the change from the Orpheus 801 (B.Or.1) in the prototype to the 803 (B.Or.3) in production aircraft was accompanied by an improvement in the high-altitude handling, because of better automatic fuel control.

The use of a British engine and other equipment also helps to make the G.91 a truly "European" aircraft for NATO, while a certain amount of airframe sub-contracting takes place among the Italian industry. The entire rear fuselage and tail assembly, for example, is built by the Piaggio company and arrives complete with the power controls installed, ready for mating with the centre fuselage.

The rudder is operated by a direct mechanical linkage from the simple rudder bar, with tab assistance, and a yaw damper is fitted to make the G.91 an optimum armament platform. Although the tailplane incidence is electrically variable for trimming the G.91 does not have an all-flying tail. The elevators are actuated by Fairey irreversible hydraulic servo-controls, with spring and "pendulum" feel, and have a system of manual reversion for emergency use. As in the F-86K, a fairing above the tail-pipe houses a tail-braking parachute, which gives the G.91 a remarkable short-landing performance.

The structure of the G.91 mainplanes is an ingenious adaptation of that used in the F-86K, but is considerably simpler and more economical to produce. The wings have a mean t/c ratio of about 9%, and are swept-back 37° at the quarter-chord line. They are built up on two main spars, with an inboard extension on the aft member for attachment of the mainwheel legs and the slotted flaps.

The spar and rib assemblies are covered by upper and lower skin panels, as in the F-86K, but whereas the American aircraft uses expensive and complex tapered skin, with longitudinal stiffening members milled out of the solid, the G.91 achieves a similar effect by conventional means. The wing skin panels have riveted spanwise L-section stiffeners which taper in depth towards the tips, and also terminate progressively so as to reduce in number.

The inner sections of the skin panels are further strengthened by sheet-metal attachments across the spanwise stiffeners, to which they are secured by explosive and high-shear rivets. The appearance of the completed wing panels is remarkably similar to those of the F-86, and the method of attachment of the mainplanes to the fuselage by multi-bolt pick-ups from the root ribs is also the same.

No fuel is carried within the wing, but fuel lines extend through the structure to the underwing pylons, which are semi-permanent attachments. They have a maximum capacity of 500 lb., and may carry two bombs, Napalm tanks, drop tanks, rocket pods with 31 2-in. R.P.s per side, clusters of six 3-in. R.P.s, or guided missiles such as the Firestreak and Nord 5103. They may also be augmented by two additional pylons further out below the wings, to carry more missiles, 19 by 2-in. capacity rocket pods or similar loads.

The ailerons are pressure-balanced by internal seals and are actuated by Jacottet hydraulic servo-control units with emergency manual reversion. The aileron control runs are accommodated within the leading edge of the wing, and there is an access panel near the tip for maintenance of the booster jacks. The G.91 is particularly well provided with access panels throughout the airframe, for simplified field maintenance. The mixture of French and English power controls in an Italian aeroplane is slightly unusual but has proved very successful, with no troubles whatsoever in well over 3,000 hr. of flight.

### G.91 In The Air

According to Commandante Marsan, chief test pilot of the Fiat company, the main characteristics of the G.91 in flight are its simplicity and manœuvrability. Ground manœuvrability is good when taxiing, even without a steerable nosewheel, the Messier toe-actuated brakes being powerful and sensitive. The

In its standard fighter-bomber form, the Fiat G.91 can operate from runways or semi-prepared strips, and with its tail-braking parachute has an extremely short landing run.

low-pressure Pirelli tyres give a soft ride, even on rough grass, in conjunction with the articulated undercarriage legs.

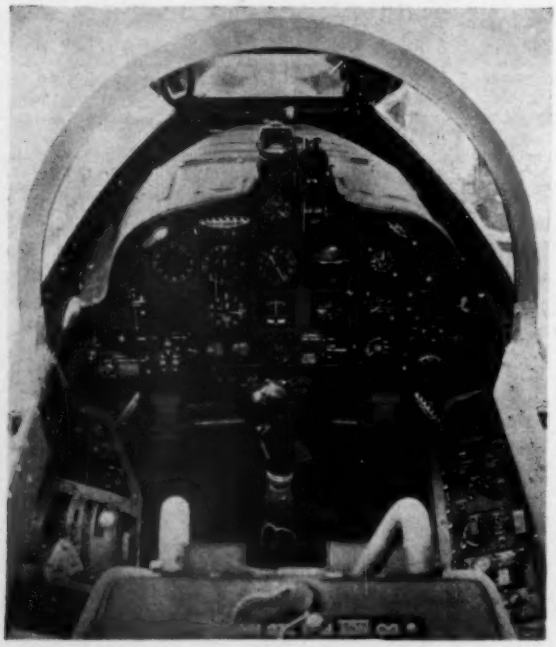
A trimmer button on the U.S.-pattern control column is used for elevator and aileron trim before take-off, the tailplane being aligned with a red mark on the indicator gauge, and the aileron tab set visually to neutral. The rudder tab is also set to neutral via an actuator switch on the port console, and yellow indicator lights on the panel. As in the case of the Sabre, the full 40° of slotted flap is used for take-off, and facilitates raising the nose-wheel to unstick. The Fairey elevator control system must be engaged before take-off, but the hydraulic servos for the ailerons remain permanently connected.

With 100% power, acceleration of the G.91 on take-off is rapid (more than 0.4 *g*), and the rudder becomes effective at about 40 knots within a couple of hundred yards. The nose-wheel can be raised at 90-95 knots, and the G.91 flies off, clean, at about 120 knots. With external stores about five knots must be added to this figure. At full combat weight the G.91 takes off in less than 3,600 ft., to clear 50 ft. Rocket assisted take-off is being explored to reduce this distance still further, and consideration is also being given to zero-length launching of the G.91 from a mobile ramp by means of a more massive rocket booster.

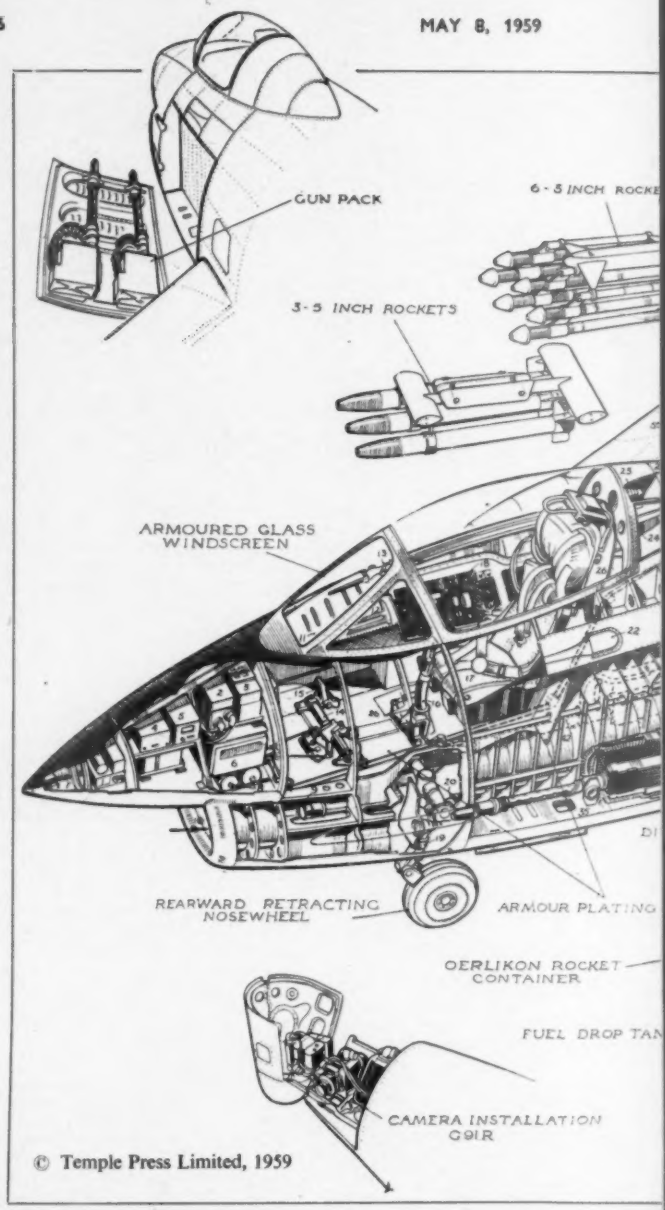
Initial climb is about 6,000 ft./min. and is maintained, at a decreasing rate, at an indicated M=0.75. With the aircraft clean it is possible to reach 30,000 ft. in about 6 min. from take-off. Normal mission cruise is at about 220 knots I.A.S. at up to 35,000 ft. or so. Static stability is stated to be positive, with a very high gradient, and dynamic stability is also reported to be very satisfactory. The manœuvrability of the G.91 may be assessed from the fact that the maximum rate of roll is about 240°/sec., while representative stick forces for elevator control are 3-5 lb. per *g*.

In its clean configuration the G.91 has a maximum level speed of 580 knots, or M=0.91 at 20,000 ft., and is transonic in a dive. Recoveries of up to 4*g* have been regularly made from speeds between M=0.95 and 0.97. The ventral airbrakes may be opened at any airspeed and at 460 knots result in a deceleration of 0.65 *g*. Their extension is achieved in 4 sec. and is accompanied by mild buffeting and a nose-up trim change which can be held with a stick force of 4-6 lb.

The minimum speed for longitudinal trimming is less than $1.3V_s$, the stall, clean, occurring at about 120 knots I.A.S. after a slight but prolonged warning buffet, and being innocuous during the breakaway. All-down, the G.91 stalls at 105-110 knots I.A.S. so that a comfortable approach speed is about 140 knots. The rate of roll is then about 100°/sec., so that good manœuvrability is retained for landing. Longitudinal stability is then excellent and the G.91 touches down at about 120 knots. With the aid of the tail-braking parachute, landing distances of about 885 ft. were achieved on the runway at Bretigny during evaluation of the G.91.



Cockpit layout of the G.91 is simple and logical, and is to NATO standards. A large proportion of British instruments and equipment are included in the cockpit furnishings.

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These details of NATO's first-generation tactical fighter show it to be a thoroughly sound concept, despite its apparently unspectacular design. It is necessarily more rugged in construction for prolonged low-level flight at high-speeds, and operation from grass surfaces, than previous tactical aircraft; but its structure weight is sufficiently low to permit the carriage of a military load, including fuel, of about 50% of its gross weight. Some 20% of this weight is represented by its armament, which amounts to about one ton of payload.

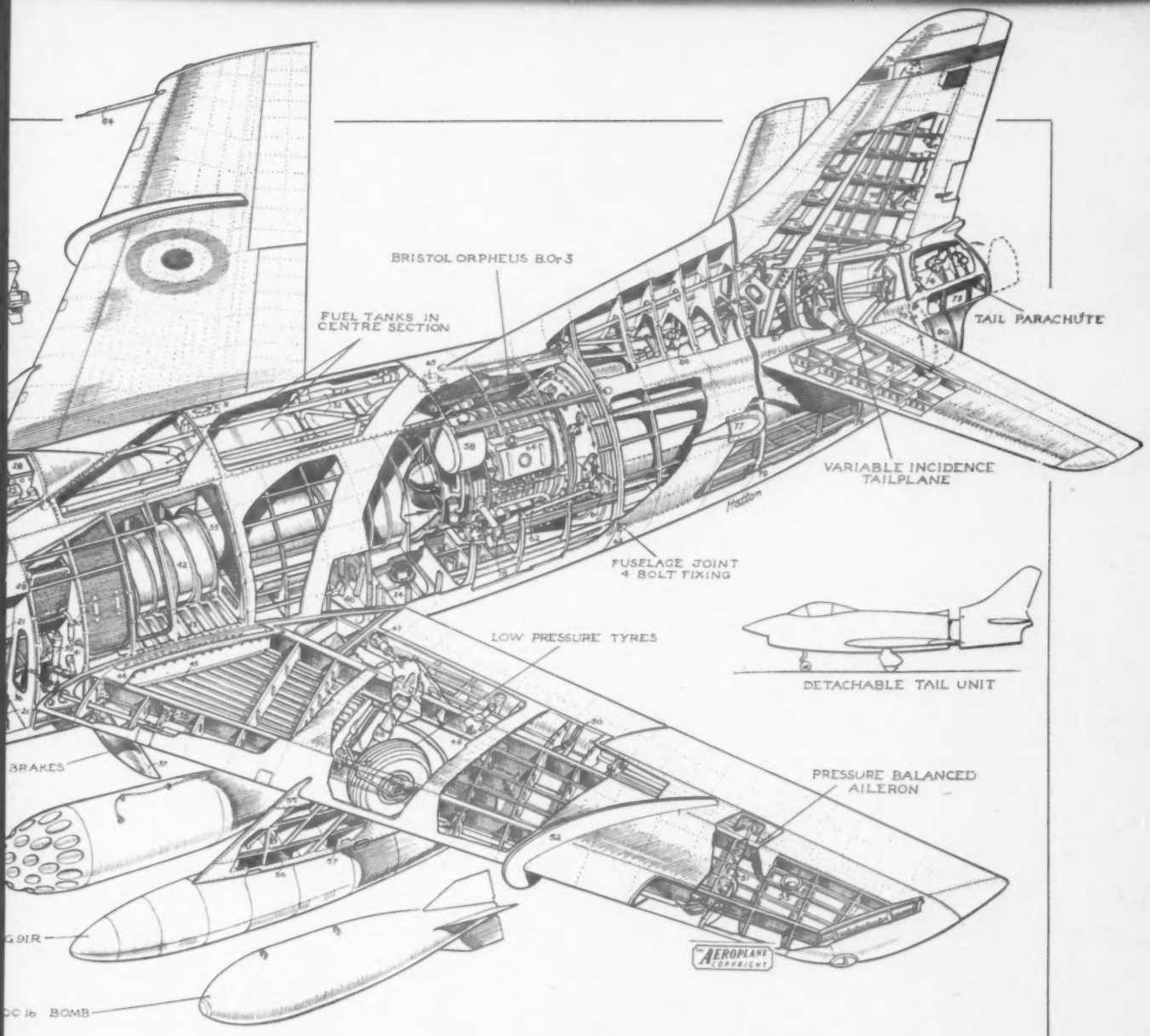
It adequately meets a difficult specification, but in addition to its flight performance, fulfils the specialized maintenance requirements of field operation. By careful design, the entire sequence of oxygen, armament and fuel reloading can be achieved in less than 10 min. by four or five men, so that the daily aircraft mission frequency will be technically limited only by the number of pilots available.—J.E.F.

**Leading Particulars**

DIMENSIONS.—Span, 28 ft. 3 in.; length, 34 ft. 1 in. (G.91T, 39 ft. 0 in.); height, 13 ft. 1 in.; wing area, 176.7 sq. ft. (G.91T, about 195 sq. ft.).

WEIGHTS (G.91T in parentheses).—Empty, about 6,600 lb. (7,055 lb.); useful load, about 4,850 lb. (4,195 lb.); normal take-off, 10,360 lb.; max. gross, 11,460 lb. (11,250 lb.).

PERFORMANCE.—Max. sea-level speed (clean), 668 m.p.h. (M=0.88); 675 m.p.h. at 5,000 ft. (M=0.9); 637 m.p.h. at 20,000 ft. (M=0.91); combat radius, including 10-min. loiter, 170 n.m.; normal sortie time at sea-level, about 1 hr.




# FIAT G.91

## One Bristol Orpheus B.Or.3

**KEY**

1. Radar dynamotor.
2. Radar transceiver.
3. Radar selector unit.
4. I.F. radio compass amplifier.
5. R.F. radio compass amplifier.
6. Radio receiver and transmitter.
7. Gun camera.
8. Oxygen bottles.
9. Single phase inverter (3 phase on starboard side).
10. Air intake.
11. Armoured glass windscreen.
12. Instrument panel.
13. Gunsight.
14. Rudder pedals.
15. Toe brakes.
16. Control column.
17. Martin-Baker Mk. 4 ejection seat.
18. Starboard instrument console.
19. Rearward-retracting nosewheel.
20. Nosewheel retracting jack.
21. Browning .5-in. machine gun (4 off).
22. Air intake to heat exchanger of cabin pressurization and air-conditioning system.
23. Cabin-pressure control valve.
24. Cabin-pressure security valve.
25. Electronic air-conditioning control.
26. Armour plating (seat back, floor, bulkhead).
27. Gyro compass.
28. Gyro-compass amplifier.
29. Fuel tank.
30. Fuel tank.
31. Refuelling point.
32. Fuel-tank pressurization piping.
33. Tank-bay skin.
34. Submerged fuel booster-pump.
35. Container for expended cartridge cases and clips.
36. Battery bay.
37. Armour plate airbrake.
38. Link support aileron control.
39. Vertical aileron-system torque-tube.
40. Artificial feel control.
41. Trimming actuator.
42. Air intake ducting.
43. Wing centre-section (top and bottom plates machined from solid).
44. Wing-to-fuselage joint.
45. Stringer/skin inboard section.
46. Undercarriage bay.
47. Undercarriage-retraction jack.
48. Inward-retracting French Messier undercarriage.
49. Electric flap actuator.
50. Flap guide-rail.
51. Aileron booster.
52. Boundary-layer fence.
53. Compass signal generator.
54. Pitot head.
55. Pylon.
56. Bomb release-gear.
57. Oerlikon rocket firing control.
58. Hydraulic oil tank.
59. Hydraulic oil filter.
60. Main hydraulic accumulator.
61. Upper engine-mounting point (3-point mounting).
62. Engine-mount bracing stay.
63. Fuselage joint bolt (4 off).
64. Engine oil tank.
65. Yaw damper gyro.
66. Elevator hydraulic booster.
67. Tailplane setting electric motor.
68. Yaw damper motor.
69. Friction drive from yaw damper.
70. Rudder trim actuator.
71. Fin attachment forging.
72. Tailplane mainspar.
73. Tail-parachute stowage.
74. Tail-parachute attachment.
75. Vortex generators.
76. UHF aerial.
77. Air intake for engine tailpipe shroud cooling.
78. Engine starter exhaust.
79. Forged formers.
80. Stainless-steel tailpipe shroud.

THE AEROPLANE MAY 8, 1959
and ASTRONAUTICS

# Flying the Tipsy Nipper

By John Fricker

IN the diminutive Nipper, the veteran Belgian designer, Mr. E. O. Tips, has succeeded with characteristic ingenuity in presenting a new and highly original version of the "minimum" personal aeroplane, for flying at the least possible cost and with maximum enjoyment.

He recently described the Nipper to me as the simplest practicable approach to ultra-light flying, but its conception goes considerably beyond what has hitherto been achieved with similar machines.

Although it retains delightful "ultra-light" handling qualities, these are coupled with better stability than in most comparable designs, but more important is its aerobatic capability. In the past, one has tended to associate ultra-light designs with an inevitable fragility, but Bernard Neefs' extraordinary aerobatic display at the Kidlington show in a howling gale, effectively dispelled that impression so far as the Nipper was concerned. As chief test pilot for Avions Fairey S.A., Neefs has done all the development flying of the Nipper, in which he has pulled no less than 7.4 *g*, and has dived to more than 173 m.p.h.

It is therefore a very strong little aeroplane, the normal maximum load factor being 5 *g*, while despite its apparently elementary lines, it cruises at a remarkable 90 m.p.h. or so on its modified Volkswagen engine. This HEPU unit has been officially tested and approved by the West German authorities, although having only single ignition. It produces up to 40 b.h.p., and is a smooth and reliable, if slightly heavy, power unit for ultra-light aircraft.

When analysed in detail, the Nipper proves to be an extremely rational approach to simplicity. The airframe is built up on a boat-shaped fuselage "chassis" of welded-steel tube of just sufficient width to contain the single seat. On this structure are hung the bungee-sprung legs of the nosewheel undercarriage and the powerplant, the cowlings, spinner and ventral fairings being of glass fibre.

The upper part of the front fuselage is formed by the light alloy 7½ gal. fuel tank; while behind the cockpit, metal formers and wooden stringers, with fabric covering, build up an elliptical section. The prototype Nipper had an open cockpit, but the drag proved to be so high with this arrangement that a moulded canopy of the optimum aerodynamic shape was developed, together with a raised rear decking, to improve both performance and handling.

The mid-wing position was chosen for its good ground clearance and to provide a roomy cockpit while keeping the fuselage cross-section to a minimum. The wing-root ribs are outboard of the top fuselage longerons, providing welcome space for one's elbows, and the gaps in the lower surfaces are filled in with transparent strips for downward visibility.

For simple construction, the virtual "plank" wing and tailplane have single spars of constant width, with plywood and fabric covering. The rudder, on the other hand, is a steel-tube framework, with fabric covering, and has no fin.

Entry into the cockpit is via a folding metal step in the port mainplane root, which is normally held in place by a ball catch. When getting in, it is necessary to keep one's weight well forward to avoid tipping the Nipper back on its tail bumper. The cockpit has a wooden glider-type seat (which I found a little hard on one's sensibilities) and is a snug, but not tight fit.

There is plenty of leg room; in fact, I found slight difficulty in locating the rudder pedals when peering under the little instrument panel mounted on the mainspar. The cockpit appointments are the simplest possible; throttle, stick and rudder pedals, basic instruments (metric in OO-NIF), and single ignition switch. Car-type oil pressure and temperature gauges flank the fabric-covered cockpit walls, and there is a simple fuel float indicator in front of the cockpit.

The Nipper is simple but not spartan, and the cockpit includes such refinements as a moulded glass-fibre hood over the instrument panel to prevent reflections in the canopy, and a spring-bias trimmer on the short stick. The latter also has a brake lever, with a parking catch, the mainwheels having light and effective disc-type brakes designed and built by Mr. Tips. The discs are of stainless steel, with cable-operated calipers, sprung-mounted and each holding two pads of friction material.

Once installed in the cockpit, with the sideways-hinging canopy secured in place and the shoulder harness secured, one begins to feel part of the Nipper, and the mainplanes sprout sideways at shoulder level like a pair of personal wings. This partially accounts for the extraordinary feeling of enjoyment in pure flying which the Nipper arouses, but equally important are the responsiveness and extremely light forces of the controls.

Initially, it seems that the wide-chord mainplanes will restrict downward view by an uncomfortable amount, but forward, there is an arc of about 150 degrees of unrestricted view in azimuth, while the steeply sloping nose and high viewpoint for the pilot give above-average visibility in elevation. The little window slots in the wing-roots also help, although they tend to get slightly oily in flight.

Starting the Nipper is by the classic method of hand-swinging the tiny two-bladed airscrew, which spins round at almost sonic tip-speed at cruising r.p.m. The absence of a choke control found in other Volkswagen installations may have been the cause of the protracted effort required for starting at White Waltham, but perhaps all that was missing was the necessary knack. Once the HEPU unit has burst into life,

with a healthy roar which reverberates somewhat in the enclosed fuselage, the only checks before take-off are for the minimum oil temperature and full throttle static r.p.m. of about 3,100.

Taxi-ing the Nipper is almost as much fun as flying it. The nosewheel is directly coupled to the rudder pedals for steering, and, with very light foot loads, the Nipper may be turned in little more than its own length, while strong winds seem to have little effect on its ground stability. A squeeze of the brake lever provides rapid deceleration as the Nipper rides along on its slightly stiff undercarriage, pitching a little on grass.

As briefed by Fairey test pilot, John Morton, I made my first take-off from the apron at White Waltham, directly into a moderate wind. Acceleration was quite rapid and the sensitivity of directional control provided a foretaste of the general handling, although there was no tendency to swing. Having been warned about the light controls, I gently applied a little aft stick, and at about 70 km.p.h. (43 m.p.h.) I.A.S., the Nipper flew itself smoothly off. On grass, it was slightly more difficult to get a smooth unstick, the Nipper tending to pop into the air at a fairly steep angle after being launched by a bump.

With the thick NACA 43012A wing section this is quite safe, but the stick must be eased slightly forward to climb away at about 85 km.p.h. (53 m.p.h.). The rate of climb, after a ground run of some 100 yards, is typical of ultra-lights at about 470 ft./min. and the Nipper requires about 300 yards to clear 50 ft.

In the air, the lack of measurable magnitude in the control forces is accompanied by excellent harmonization and crisp responsiveness throughout the speed range. With its generous dihedral, however, and well-distributed keel surfaces, the Nipper has first-class stability characteristics and does not seem as susceptible to rough air as other ultra-lights. Another noticeable feature is the absence of any trim change, and after trying the lever at the base of the stick, I left it fully aft the whole time.

No doubt the possibility of fine trim is useful on long cross-countries, of which the Nipper is quite capable. At 3,200 r.p.m. or so, when a very useful cruising speed of some 145 km.p.h. (90 m.p.h.) is returned, the consumption cannot be more than two gallons per hour, giving a safe cruising range of 3¼ hours, and the extraordinarily good a.m.p.g. of 45. The Nipper will also take up to 10 lb. of luggage behind the pilot, providing that worthy does not weigh more than 210 lb. In other words, the Nipper will take drivers of up to nearly 16 stone, if they are content to take only a tooth-brush with them.

Flat out, at about 3,400 r.p.m., the Nipper wound up quite rapidly to about 160 km.p.h. (100 m.p.h.), which is the maximum five-minute level speed.

In this view of the Nipper cockpit can be seen one of the wing root recesses for additional elbow room, and other features of the simple layout.

Despite the low power available, it did not take long to climb to 3,000 ft. for some more advanced exploration of the Nipper's handling, after an air-to-air photographic session which fully demonstrated the general controllability. Small stick movements, with thumb and finger, are sufficient to place the Nipper precisely where required at all times, and in the power-off stall, little aft stick is necessary. At about 50 km.p.h. (31 m.p.h.) I.A.S., the nose and starboard wing dropped fractionally with little warning and then the Nipper was flying again, while with power on, the speed fell to about 45 km.p.h. (28 m.p.h.) I.A.S., at an exaggerated angle, before a similar thing happened. Control effectiveness remained throughout.

Thus reassured, I embarked on a tentative series of aerobatics, to which the delightful qualities of the Nipper had been steadily beckoning since take-off. Loops required only a delicate few inches of stick movement between the entry dive to 160-170 km.p.h. (100-105 m.p.h.) and going over the top in an incredibly tight radius. In rolls, at a slightly slower speed, the effective ailerons on the short-span wings snapped the aircraft round remarkably rapidly, with the assistance of a little rudder, and there was barely time for the engine to cut under negative *g*.

Stall-turns and rolls-off-the-top are equally satisfying to perform, still with negligible stick forces, and although a ham-handed pilot could possibly overstress the Nipper by an incautious and determined tweak of the stick above 100 m.p.h., he is unlikely to exceed the limiting dive speed of 235 km.p.h. (146 m.p.h.). I did not spin the Nipper, but I gathered that its characteristics are entirely normal, with an added reluctance both to enter a spin and to stay in it.

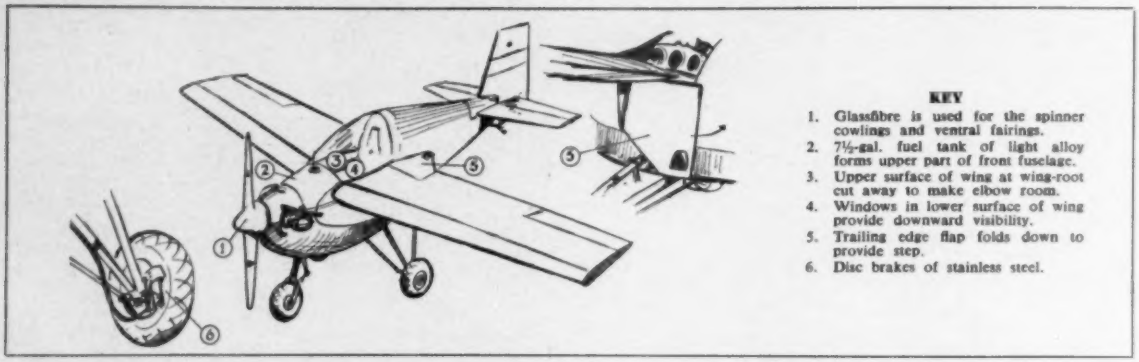
Throttled back, with full aft trim, the Nipper glides at about 100 km.p.h. (62 m.p.h.), which is slightly more than the optimum, but the approach speeds are completely uncritical. Even at the recommended 85 km.p.h. (53 m.p.h.), the glide is fairly steep, and may be adjusted by gentle sideslips as the Nipper has, of course, no flaps. After a brief float, in which there is initially a slight tendency to "pump-handle" with the sensitive elevator, the Nipper touches down on its main-wheels, at about 68 km.p.h. (42 m.p.h.) and pitches forward on to its nosewheel. Providing the rudder pedals are centralized just before touchdown, cross-wind landings are just as simple.

My flight in OO-NIF was one of the most enjoyable I can remember, but I think the aircraft demonstrated equally that it is more than just a toy for local circuits. Delightful as it is at the moment, however, to contemplate a Nipper with perhaps a 65 b.h.p. Continental would offer the prospect of a vehicle without parallel anywhere.

A series of 50 Nippers is being built at the moment at

For his first take-off in the Nipper, the author used the tarmac strip in front of Fairey's helicopter hangar at White Waltham, and was airborne in little more than a hundred yards.

*Photographs copyright "The Aeroplane and Astronautics"*


KEY
1. Glassfibre is used for the spinner cowlings and ventral fairings.
2. 7½-gal. fuel tank of light alloy forms upper part of front fuselage.
3. Upper surface of wing at wing-root cut away to make elbow room.
4. Windows in lower surface of wing provide downward visibility.
5. Trailing edge flap folds down to provide step.
6. Disc brakes of stainless steel.

Gosselies, OO-NIF being the sixth, and the aircraft should be available in this country for less than £1,000 duty paid. Alternatively, a kit of parts containing the welded steel fuselage, all the metal parts, the necessary timber, a set of drawings, illustrated building instructions and the various mouldings is being offered at about half that price for completion by the amateur constructor. The engine, airscrew, instruments and so on can also be supplied at additional cost.

**Leading Particulars**

DIMENSIONS.—Span, 19 ft. 8 in.; length, 14 ft. 9 in.; height, 5 ft. 3 in.; wing area, 80.5 sq. ft.

WEIGHTS.—Empty, 360 lb.; pilot, 220 lb.; fuel, 54 lb.; oil, 5 lb.; maximum gross, 660 lb.

PERFORMANCE.—Max.-level speed, 100 m.p.h.; cruising speed, 90 m.p.h.; stalling speed, 33 m.p.h.; take-off run 110 yards; landing run, 130 yards; cruising range, 315 miles; max. endurance, 4 hours.

# Operation Broken Carcase

THERE is probably some kind of mathematical equation to suit the human circumstance whereby the fewer people there are to do a given job, the harder they seem to work at it. "Spirit" is, I think, the key word. Recently, it manifested itself after a Britannia had, through absolutely no fault of its own, overshot the end of Runway 21 at Rangoon Airport and finished up distinctly unshipshape, sans undercarriage and with the nose held on only by the captain's lapstrap. Nobody was hurt but the damage was so extensive that the insurance people had to use their gold-plated slide-rules before deciding that G-ANBC was worth rehabilitating.

So on January 9 a Hunting Clan Britannia 317, with 30 people and 12,000 lb. of spares and tools, took off from Filton at an all-up weight of 180,000 lb. Eight and a half hours and 3,250 miles later, it landed at Bahrein, a total achievement unmatchable by any other aircraft in service today. Rangoon, 3,000 miles farther on, was reached in another 8 hours. This performance was backed up on March 17 when a Britannia 252 took a little longer to transport 34 people and a 16,000 lb. load on the same run.

A basic working party of 14 Bristolians settled down at Rangoon Airport to work 10 hours a day, most days of the week. Electricians turned riveters, instrument men bashed tin, fitters tackled everything. Even Maung Ho, driver of the party's Wingate-vintage bus, joined in and riveted competently in all directions.

The lowest recorded temperature was 79 degrees—it reached 120 in the hangar—and everybody shed clothes and weight, especially Freddie Wigmore (fuel tanks and systems) and "Ginger" Wadner (electrics) who were barbecued almost daily inside a wing. For a change, one could work up a cold sweat by taking a ride (Mach = 0.1) in a local brake-less Jeep taxi.

DON STEWART
Bristol's Britannia Manager

Overseas representatives usually have their own brand of this "spirit" we've touched on. They always seem to know who and where—"Service with a drink" sums it up for me. In the best tradition were B.O.A.C.'s Frank Willett, Stn. Engineer, and Malcolm Joseph, Stores Officer, and A.R.B.'s local man, Bill Brown, who provided practical aid and comfort to Bristol's chief stressman Horace King and senior structures foreman, Freddy Price.

WALTER GIBB
Bristol's Chief Test Pilot

"Wroundabout" once said: "Those who can't do, instruct: those who can t instruct, inspect." Messrs. Butler, Morgan, Tiley, Walsh and Watts, Inspectors all, proved how wrong a columnist can be.

Don Stewart, Bristol's Britannia manager and engineer in charge of the operation, came out on both the Britannia flights, bringing on the second one a completely fabricated radio set-up.

Then with "BC" ready to go, came loading. Burmans are not a physically strong race and Don, who is Australian, watched with growing impatience the slowness with which things were moving. At last he seized a large case which normally would have taxed him to move it an inch, picked it up and heaved it to Frank Webb, Electrical Supt., who was stacking 'em up inside. Alas, the Burmans took this not as an example but as a precedent and from then on anything bulky was pointed to with the appeal "Master, heavy!" Later, the harassed "Master" saw a Burman squatting on his haunches and ordered him to get up and work. At the end of the long day, the Burman approached Don and said "Really, I do not work here—I am a visitor."

One of Burma's many holidays added another day but eventually Don was able to nominate a day for the test flight and arranged for calls at 05.00 hrs. for an 06.30 hrs. flight. But late that night it was clear there'd be a delay so he cancelled the early calls. At 05.00 hrs. he was awakened to confirm the cancellation. In Burma, you can't win.

A faulty engine had the accessory drive blanked off, eliminating that engine's alternator and the auto pilot. The main undercarriage doors had been removed and the nose wheel fixed down and its well faired over. In this fashion she flew home, unpressurized, at 8,500 ft. and 205 knots true, in easy stages, piloted by Walter Gibb, Bristol's chief test pilot.

To end this epic story, here is Walter Gibb's cable to Bristol from Rome: "GOLF ALFA NOVEMBER BROKEN CARCASE ARRIVED ROME BY HAND WITH FOUR BURNIN THREE GENERATIN TWO UP AND ONE DANGLING."—WREN.

# POWER FOR SUPERSONIC AIRCRAFT

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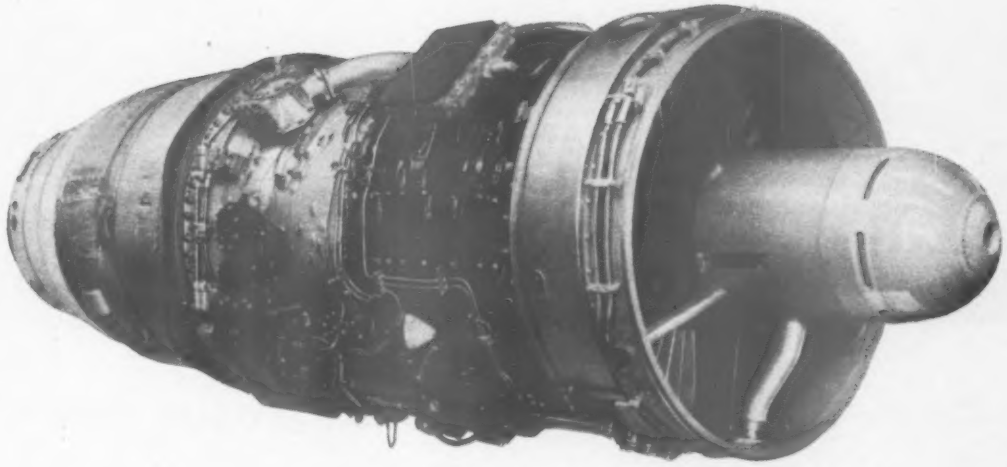

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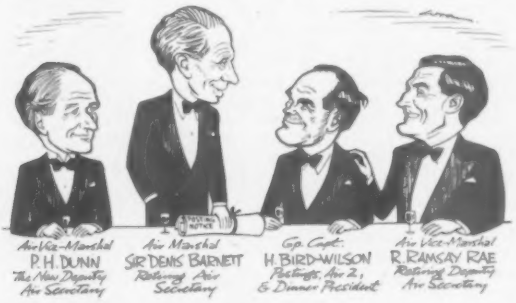
# The Fighting Services

## Postings, Promotions and Personal Affairs

TWO years' work of immense importance was touched on at the dinner, held at the R.A.F. Club on April 23, given by the staff of the Air Secretary's Department to the first Air Secretary, Air Marshal Sir Denis Barnett, K.C.B., C.B.E., D.F.C., to mark the end of his tour in that appointment.

The Department was formed in February, 1957, with responsibility for matters affecting officers' careers, appointments and personal affairs. It works within the Department of the Air Member for Personnel, who continue to represent officers' affairs on the Air Council. However, the Air Secretary has direct access to the S. of S. for Air and all members of the Air Council. In effect, the new Department assembles, within the one organization, interests and responsibilities which in the past were more widely distributed, and has introduced new facilities. For the first time officers




have direct access to the Air Ministry on problems affecting their careers. They are invited—indeed, encouraged—to discuss their affairs at the Air Ministry and during regular tours made by the Air Secretary and his staff.

At the dinner, AIR VICE-MARSHAL R. RAMSAY RAE, the retiring Deputy Air Secretary (he will be, from June 15, A.O.C. No. 224 Group, F.E.A.F.), spoke warmly of Sir Denis' work in setting the new venture on its feet.

SIR DENIS BARNETT, who has now taken over Transport Command from fellow New Zealander Air Marshal Sir Andrew McKee, thanked his officers for their support, especially during the Department's formative period when the onset of redundancy made it all particularly difficult. Their first aim, he said, had been to generate confidence and enthusiasm.

"We're here to do business with officers on a personal basis" was a remark made during the evening. So far they have dealt with more than 2,000 queries from officers seeking guidance, so business is good and it's certain that the new Air Secretary, Air Chief Marshal Sir Theodore McEvoy, will see to it that it continues to be so, to the benefit of their customers and the R.A.F.—WREN.

## No. 2 Squadron's Reunion Dinner

ON April 10 a large gathering of past, present and honorary members of No. 2 (A.C.) Squadron, R.A.F., were to be found in London enjoying the first annual reunion organized by the newly formed No. 2 Squadron Dinner Club. All ranks were represented and included Sir Francis Festing (Chief of the Imperial General Staff), Air Marshal Sir Richard Jordan, Air Vice-Marshals W. A. Opie and L. W. Cannon.

Introducing the C.I.G.S., Air Vice-Marshal Opie, who was the reviewing officer at the Squadron's birthday parade last year, recalled the unit's early history and its long and happy association in the army co-operation rôle. Sir Francis, who served as an Army liaison officer at Hawkinge in 1936 and 1937, humorously recounted the debt he owed the Squadron for the many week-end navigation exercises conveniently flown.

The secretary brought the older members up to date regarding the more recent activities of the Squadron (Sqn. Ldr. C. Wade) now flying Swift Mk. 5 low-level reconnaissance aircraft at Jever in Germany. He read a letter of goodwill from a disabled veteran who went with the Squadron to Montrose, Scotland, in January, 1913, when "Shiny-Two" became Britain's first independent squadron by taking up new quarters away from the parent Royal Flying Corps establishments.

Air Cdre. "Pat" Huskinson, C.B.E., M.C., who flew with the Squadron in 1916, recounted some entertaining and lively anecdotes of life in the First World War in France, and added that he was pleased to note that the same irrepressible spirit exists in the 2nd T.A.F. today.

Despite the good attendance, and particularly in view of No. 2's long record of service, there must be many ex-members scattered throughout the country who have not yet heard of the Dinner Club. They can obtain details and information from the secretary—Sqn. Ldr. C. S. MacDonald, at the R.A.F. Selection Board, Cranwell, Sleaford, Lincs.

In 1962 the Squadron will celebrate its 50th birthday, and by then the club members hope to have completed the presentation of ceremonial swords; already a handsome offer has been made by Wg. Cdr. "Tiny" Stilwell of Cornwall.

## Education Branch Dinner

AIR MARSHAL SIR GEOFFREY TUTTLE, Deputy Chief of the Air Staff, replied to the toast of "The Guests" at the 11th annual dinner of the R.A.F. Education Branch, held at Over-Seas House, London, on April 10.

The other guests included Air Marshal Sir Arthur McDonald, Technical Training Command; Mr. A. L. M. Cary, Assistant Under-Secretary of State (Personnel), Air Ministry; Mr. A. A. Part, Under-Secretary, Ministry of Education; Air Vice-Marshal H. H. Chapman, Director-General of Technical Services; Instructor Rear Admiral J. Fleming, Director of the Naval Education Service; and Air Vice-Marshal T. U. C. Shirley, Fighter Command.

The toast of "The Guests" was proposed by Air Vice-Marshal A. C. Kermode, Director of Educational Services, and Gp. Capt. F. J. M. Pryer was in the chair.

## Bomber Command Appointments

AIR VICE-MARSHAL T. A. B. PARSELLE, C.B.E., takes over the post of Senior Air Staff Officer at Headquarters, Bomber Command, on May 8. Commanding Task Force "Grapple" since October, 1958, he was previously A.O.C. and Commandant of the R.A.F. College, Cranwell. Before going to Cranwell he commanded the R.A.A.F. College at Point Cook on a two-year exchange posting.

The Senior Air Staff Officer at Bomber Command since June, 1958, Air Vice-Marshal J. G. Davis, C.B., O.B.E., has been appointed A.O.C. of No. 1 Group with effect from June 14. Director of Plans at the Air Ministry for the previous three years, he took the 1955 course at the Imperial Defence College.

## R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

**Air Ministry:** Gp. Capt. L. F. Stanley, and Wg. Cdr. E. J. C. Smither to the Department of the Air Member for Personnel.

**Bomber Command:** Wg. Cdr. W. D. Robertson, D.F.C., A.F.C., to R.A.F. Marham to command No. 207 Sqn.; Sqn. Ldr. F. Bel'am to R.A.F. Upwood, for technical duties with acting rank of Wg. Cdr.; Sqn. Ldr. H. Edwards, D.F.C., to Headquarters for administrative staff duties, with acting rank of Wg. Cdr.

**Fighter Command:** Wg. Cdr. N. F. T. Robinson to R.A.F. Turnhouse for Provost duties; Wg. Cdr. C. W. Coulthard, A.F.C., to Headquarters, for operations duties.

**Flying Training Command:** Sqn. Ldr. B. S. Martin to Directing Staff, R.A.F. Staff College, Bracknell, with acting rank of Wg. Cdr.

**Maintenance Command:** Wg. Cdr. A. M. Paterson, O.B.E., to Headquarters, No. 41 Group, for technical staff duties.

**Technical Training Command:** Gp. Capt. A. Gollan, O.B.E., to Headquarters as Command Accountant; Wg. Cdr. J. L. Davey to No. 12 School of Technical Training, R.A.F. Melksham, to command, with acting rank of Gp. Capt.

**R.A.F. Germany (2nd T.A.F.):** Sqn. Ldr. N. E. Bowen to R.A.F. Jever to command Flying Wing, with acting rank of Wg. Cdr.

**Middle East Air Force:** Sqn. Ldr. G. K. N. Lloyd, A.F.C., to Headquarters for staff duties, with acting rank of Wg. Cdr.

**Far East Air Force:** Wg. Cdr. H. E. White, D.F.C., A.F.C., to Headquarters for planning duties; Wg. Cdr. R. N. G. Allen, D.F.C., to Headquarters, No. 224 Group for planning duties.

**Other Appointments:** Wg. Cdr. G. W. Buckland, D.F.C., to R.A.F. Eastleigh, Kenya, for Operations Plans duties, and as Air Attaché, Addis Ababa.

## Reunions

**Bomber Command.**—The 14th annual reunion of the Headquarters Bomber Command Association of Officers is being held at R.A.F. High Wycombe on May 23. Any members who have not received details should apply to the hon. sec. of the Association at R.A.F. High Wycombe, Bucks.

**No. 601 Squadron.**—The annual Old Comrades Association reunion dinner will be held at Chevrons Club, Dorset Square, London, on May 23. Guest of honour will be Air Chief Marshal Sir Thomas Pike. Details from Mr. W. J. Kentish, 35 Floriston Court, Whitton Avenue West, Northolt Park, Middx.

# ASTRONAUTICS and MISSILES

**J. R. Cownie describes—**

# Thor Production at Douglas

## *2,500-n.m. Range possible with Developed Missile*

MORE than 100 Thor IRBMs have already been built by the Douglas Aircraft Co. and future development of this missile could give it the 2,500-n.m. range of the British Blue Streak LRBM—these were only two of the interesting facts which emerged recently when British journalists visited the Douglas plant at Santa Monica, California, where Thors are assembled. Other Douglas factories at Long Beach and El Segundo also contribute to Thor production.

To Douglas must go a major part of the credit for bringing the Thor into service little more than three years after it was first ordered. The overall Thor programme has been directed by the Ballistic Missile Division of the U.S.A.F., which assigned to Douglas the responsibility for airframe fabrication, systems integration, missile testing and the development of ground-support equipment. In effect, Douglas has been responsible for proving the entire Thor weapon system as well as being the integrating contractor for Thor deployment and training.

The other major contractors are Space Technology Laboratories, for management of the weapons system; Rocketdyne, responsible for propulsion; AC Spark Plug, which supplies the missile's all-inertial guidance system, and General Electric, which produces its heat-sink re-entry nose-cone.

### Thor Details

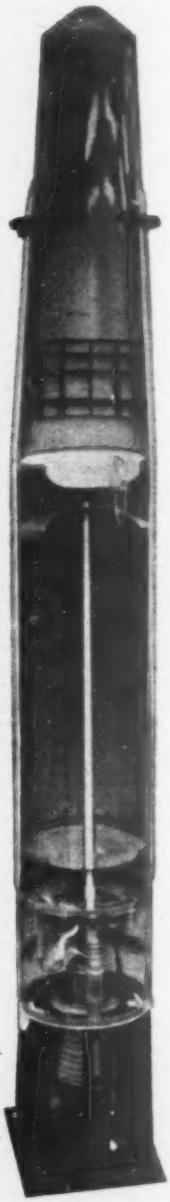
Details of the Thor were given by Mr. R. L. Johnson, the Douglas chief engineer for missiles and space systems. He described the Thor by working downwards from its heat-sink nose-cone and warhead, about which he could give no details. Below the nose-cone is the guidance section, some 10 ft. long. This is of typical aircraft construction, built in light alloy with an outer skin, stringers and hoop frames. A large hinged door gives access to the inertial-guidance gyro pack and electronics pallet, as well as to the autopilot unit, batteries and inverter, which are also in this section.

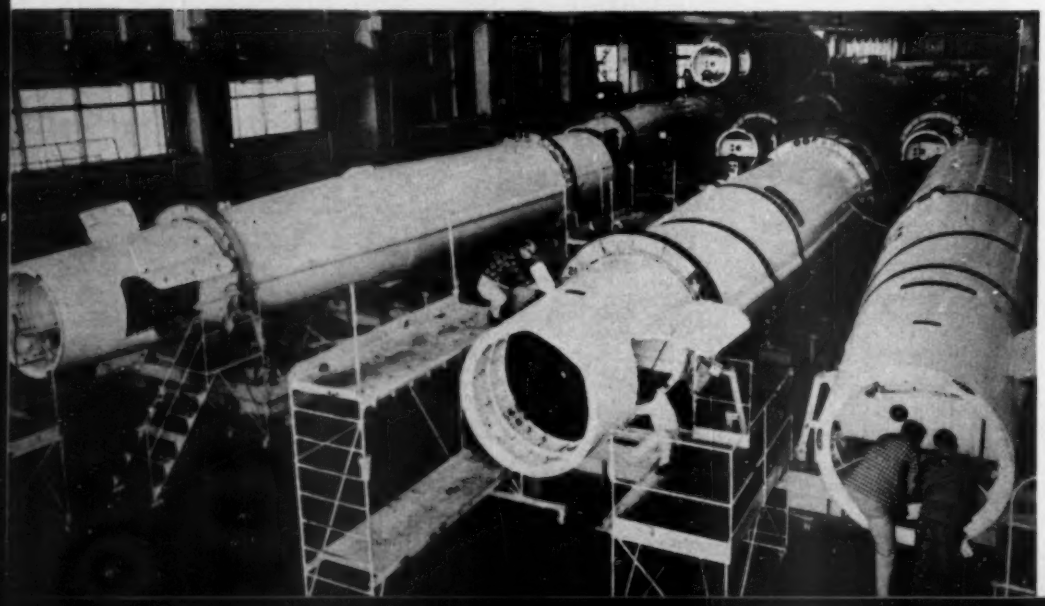
Below the guidance section is the fuel tank which holds RP-1—rocket propellent 1—a fuel similar to aircraft kerosene. This tank and the large oxidant tank beneath it form most of the Thor airframe; both are of integral construction. They have an aluminium-alloy skin, ¼-in. thick, with a waffle pattern of 3-in. squares chemically etched on its inner surface to lighten the structure. The skins are etched flat and then rolled to form 120° arcs which are welded at their edges to form the tubular tanks. Light-alloy frames inside the fuel tank act as anti-slosh baffles. At the ends of each tank are heavy dished bulkheads formed from pressings welded together.

The fuel and oxidant tanks are separated by a short inter-tank bay of skin-stringer construction. Mounted in slots on the outer wall of this bay are two forward-facing solid-fuel rockets; these retro-rockets are fired after engine cut-off to decelerate the main body of the missile and ensure that the nose cone and warhead separate from it clearly. The main body of the Thor disintegrates and burns up on re-entry.

Fuel is taken to the rocket motor through an insulated pipe which passes through the oxidant tank. All control and electrical connections between the guidance and propulsion sections pass through two spine fairings which run down the outer walls of the tanks.

Beneath the oxidant tank is the propulsion section, again built on conventional aircraft lines, in which are mounted the main Rocketdyne motor and two small vernier motors.





Final assembly and check-out of Thor is completed at the Douglas Santa Monica plant. The glassed-in model above shows Thor layout: top to bottom are nose-cone and warhead; guidance and autopilot bay; RP-1 fuel tank; inter-tank bay which houses two retro-rockets; liquid-oxygen tank; and the Rocketdyne main and vernier motors.

The design emphasis in the Thor airframe has been on ruggedness and reliability rather than on extreme lightness. It does not rely on tank pressurization for structural rigidity as does the Atlas; in fact, its structure is so strong that it is cradled for handling only at the two ends of its tank section, which are about 40 ft. apart.

A visit to the production lines showed that Thor production is well advanced—one Thor seen was numbered 227. In fact this was probably the 127th Thor to be built; during a visit to Cape Canaveral it was said that the fourth Thor to be fired was numbered 104.

To date 41 Thors have been launched, either as IRBMs or as space or re-entry vehicle boosters. Another 40 are said to be earmarked for research duties and there are to be five Thor squadrons—four British and one American—each with 15 missiles. In fact, each squadron may well have as many as 20 Thors, to ensure that 15 are always operational; in this case it is possible to account for 181 of these missiles in all. Even if 200 Thors have been ordered from Douglas, it seems that production of this missile must end within perhaps a year unless more advanced versions are produced or other NATO countries are to adopt this IRBM.

Thor operation was described by Mr. Johnson. The ground-support equipment is vital to the success of the missile and makes up more than 80% of the cost of the entire weapons system. This equipment, which consists of a series of support, check-out and launch-control trailers, maintains the missile so that it is ready for launching at all times.

At launching sites the missile is stored horizontally under a protective shed so that it can be easily maintained. When it

MOTOR BAY—The Rocketdyne main and vernier motors are installed in a power-plant section before each Thor is finally assembled. The outlet above the main thrust chamber is the turbo-pump exhaust.

is to be launched an automatic count-down sequence begins; this is designed to take only 15 min. but is monitored by the launch controller who can impose holds if snags arise. During this sequence the missile is erected, fuelled and launched. The erector supports the missile at the beginning of this stage because it is very light and could be blown over. When loaded with propellents the missile is stable on its launch platform and can be launched in winds up to 60 knots.

After the launch the main Rocketdyne motor runs for 156 sec.

GUIDANCE SECTION—Typical aircraft-type skin, stringer and frame construction is used for Thor's guidance section.

Its thrust is cut off when the missile is travelling at about 25 ft./sec. below the desired velocity for the ballistic trajectory, fine control of the final velocity is given by the verniers, which operate for about another 9 sec. During this time the Thor is accelerated gradually to its precise cut-off speed. Close control of the final speed is essential, as an error of only 3 ft./sec. in the velocity of about 15,000 ft./sec. will result in an impact error of one mile.

**Development Potential**

In a question-and-answer session Mr. Johnson said that there was no reason why Thors should not be launched from "hard" underground sites. The missile system had been designed in its current form only so that it could enter service as soon as possible.

Asked if development difficulties had been caused by the Douglas policy of building all Thors on production tooling, Mr. Johnson said that only small changes had been found necessary during the test programme—"You certainly don't get to the position where you have to jack up the nose cone and verniers and run in a new missile between them."

Mr. Johnson said that the Thor had considerable development potential; its range could be extended at least 1,000 n.m. to bring it into the class of Blue Streak without sacrifice of payload. To do this, he implied, more advanced propellents would be required, but no external changes in the size and shape of the Thor would be necessary. He mentioned the Douglas policy of continuous development, and said that the Thor might turn out to be "the DC-3 of space efforts."

**Thor Details**

LENGTH.—65 ft.
DIAMETER.—8 ft.
PROPULSION.—Rocketdyne MB-3 rocket motor of approx. 150,000-lb. thrust plus two vernier motors.
GUIDANCE.—All-inertial system by AC Spark Plug.
LAUNCHING WEIGHT.—110,000 lb.*
PROPELLENT WEIGHT.—97,000 lb.*
NOSE-CONE PLUS WARHEAD WEIGHT.—3,000 lb.*

*Estimated values.

# *Britain's Part in Space Exploration*

BY the time these words are read, the Government's long-awaited statement regarding the part Britain might play in space research should have appeared. Although at the time of going to press, little is known about the details of such a programme, it seems clear that any work we undertake will be complementary to the American effort. Indeed, it is expected that much of the experience the Americans have already acquired in space-research will be made available to scientists here so that we would begin under the most favourable possible conditions, and so avoid costly duplication of scientific effort.

What we eventually do in this field depends on many factors. Clearly we can make our own contributions to geophysical research with artificial satellites, but other opportunities are already on the horizon. With an eye on "practical" outlets for satellite research, the most rewarding avenues appear to lie in weather study—with obvious implications for global reconnaissance and world mapping—and radio and T.V. communications.

As we have already pointed out (THE AEROPLANE for April 17), any initiative we take in this field will depend on the availability of the Blue Streak LRBM as a booster. But as this potent vehicle will not be ready for flight-testing until next year—and a long period of trials must inevitably follow—it might be wise to take advantage of the offer made by the United States under the COSPAR arrangements for British-built apparatus to be launched in American satellite vehicles. This would be a valuable beginning, but beyond such experiments lies the need for long-term planning.

At an early opportunity, a committee representing the R.A.E., the industry and relevant scientific bodies, including, of course, the British Interplanetary Society and the Royal Aeronautical Society, should be set up to keep under constant review the fast developing science of astronautics, and advise the Government of ways in which the U.K., preferably with Commonwealth backing, could make maximum use of its opportunities.

The tremendous cost of space-development places obvious limitations on what this country can usefully attempt, with or without the Commonwealth, and although it is vital that we acquire the necessary background of industrial experience in astronautics by building our own satellites and launching

vehicles, no barrier should be put in the way of collaboration with other space-active nations where special projects are involved.

An example of how such collaboration might operate is in a study recently made by the British Interplanetary Society, the purpose of which is to explore the possibilities of a joint project with the United States to land instruments on the Moon. The background to this proposal is the work now in progress in the United States with clustered rocket engines which, with suitable staging, should have little difficulty in projecting into lunar orbit probe vehicles capable of making controlled landings with research instruments and radio equipment.

The vehicle proposed by the B.I.S. is called Migrant (Moon, Instrumented Guided Rocket and Notifying Transmitter); a model shows the general layout. Its purpose would be to obtain direct surface measurement, perhaps carry out seismic investigations of the Moon's crust and interior, and prove techniques for future manned landing vehicles.

It is estimated that experiments of this kind may be possible when vehicles of 1 to 3 tons—depending on payload capacity—can be sent into orbit around the Moon. The maximum use of miniaturized components has been assumed to keep the size and weight down to a minimum.

Nevertheless, a "minimum" Moon-landing vehicle is likely to be a rather sophisticated device, for its guidance system must embody attitude control to enable it to "sense" its relationship with the lunar surface (e.g., using photo-cells acting on the Moon's sunlit face), an auto-stabilized braking rocket motor and a rather complex system of altitude control. In addition, landing-legs must be provided so that the vehicle has every chance of landing effectively in a tail-first attitude. These legs are folded into the nose-cone of the carrier rocket during transit.

### Landing Sequence

The landing sequence of the proposed vehicle is as follows:—

(a) Carrier rocket—with Migrant in nose—arrives in orbit around the Moon.

(b) Migrant landing vehicle separates from carrier rocket and its rocket motor is fired against direction of motion to kill orbital speed.

(c) Landing vehicle drops towards Moon's surface on a curved path, stabilized by gimbal-mounted rocket motor which also serves to slow down and finally halt the descent on the surface. (During descent, motor thrust would be regulated in accordance with information supplied by a radio-altimeter which continuously feeds "distance-from-surface" data into a computer which, in turn, controls the thrust of the rocket motor.)

(d) After landing—on the Earth side of the Moon—a timing device brings instruments and transmitter into operation and coded signals are sent back to Earth over the radio link.

With robot research stations on the Moon, it should be possible to determine the nature of the Moon's crust in addition to obtaining information about surface temperatures and the characteristics of any surface gases which might exist. Experiments to determine the average number of micro-meteorites reaching the Moon could be made; also study of the natural radioactivity.

Investigation of the Moon's interior might follow if there was no objection to causing artificial tremors; i.e., one of the vehicles might throw out a high-explosive projectile. If this were done, it is theorized that the resulting explosion would create pressure waves in the Moon's crust which, recorded by seismographs in the robot landing vehicles, might reveal its thickness and perhaps discover whether the Moon has a liquid core. Similar experiments performed on Earth during earthquakes have shown that as the pressure waves travel through the crust they are reflected in various ways, and from the complicated patterns recorded it has been possible to determine that the Earth is formed of concentric layers of different materials.

### Radio Marker-beacon

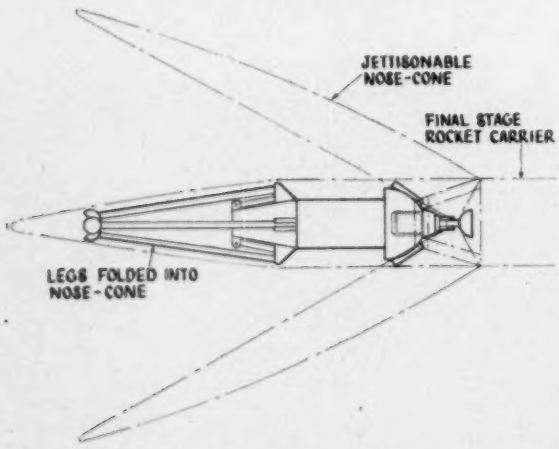
Information picked up by the Migrant vehicles would be coded electronically within the probes and transmitted to receiving stations on Earth using a 1-2-watt transmitter. Power would be supplied by three large solar cells which generate electricity directly from sunlight to recharge chemical storage batteries.

Landing robot vehicles of this kind would be an essential preliminary to the landing of manned vehicles, and it has been further suggested that Migrant could act as a radio marker-beacon for the grouping of automatic supply vehicles prior to any attempt to put men on the lunar surface.

Although similar schemes must be under consideration in America, the problem of getting instruments on to the Moon in a controlled way is unlikely to be easily solved, and it might well be that the United States would welcome collaboration along these lines—perhaps as a "back-up" to a project of their own. After all, vehicles of this general character will be a fundamental to the exploration of the Moon and British experience with low-thrust "throttleable" rocket engines would seem particularly relevant to such a project, to say nothing of certain techniques we have acquired with VTOL aircraft.

Even with their vast resources, the U.S.S.R. and the United States cannot expect to do everything in the space field at once. Indeed, there is growing criticism of lack of co-ordination in the U.S. programme, amounting to waste of scientific effort. Admittedly, attempts to send probes to Venus this year seem more in the nature of hastily conceived prestige experiments than carefully planned research missions. Before such experiments pay useful dividends, a great deal more fundamental research would seem to be needed on stabilized platforms, guidance and tracking, and one has the feeling that as astronautics develops, many "gaps" will be left behind requiring specialized attention.

Undoubtedly there will be room for a "third-party" in space and once we can get down to a thorough examination of all the prospects, Britain and the Commonwealth may yet have a significant rôle to play. But planning must be the keynote.



Above, sketch diagram of Migrant fitted to final-stage carrier rocket, and right, Woodrow Wyatt and Kenneth Gatland discuss features of the Migrant probe on B.B.C.'s "Panorama."

If we hope to have any useful part in astronautics beyond the launching of artificial satellites, we must make up our minds on a firm policy stretching beyond the concept of a Blue Streak launcher.

The first thing we must do is to get the right people round a conference table—and thrash out all the possibilities. Not until then can we be sure that we cannot afford space-ventures that will give our scientists and engineers the opportunity to work in the forefront of space-exploration instead of trailing in the rear.

## Cut-price Satellite

WELCOME evidence of reducing costs in at least one area of America's Space Programme is to be found in the contract recently awarded to Chance Vought Aircraft, Inc., for the Scout four-stage all-solid satellite-launching vehicle.

The Scout is designed to boost 150-lb. satellites into nominal 300-mile orbits, and an alternative version, used as a ballistic probe, will be able to lift payloads of 100 lb. to altitudes of more than 5,000 miles. The U.S.A.F. plans to use modified Scout rockets in a number of unspecified high-altitude experiments.

Each launching vehicle will cost about $500,000, a comparatively modest sum for rockets of this capability. Chance Vought will build the airframe and integrate the four solid-propellent stages as follows: 1, a modified version of an early Polaris engine by Aerojet-Generation Corpn.; 2, an improved Thiokol Sergeant; 3, a scaled-up version of the Vanguard third-stage by Allegany Ballistics Laboratory, and 4, a standard Vanguard third-stage, also by A.B.L. A simplified gyro-control system and spin-stabilization devices are being supplied by the Minneapolis-Honeywell Regulator Co.

With final assembly taking place at NASA's Langley Research Centre, Langley Field, Va., initial firings are scheduled for mid-1960 from the Pilotless Aircraft Research Station located on Wallops Island off the Virginia coast. Chance Vought will also provide the launcher.

## Contract for Liquid Hydrogen

USE of liquid hydrogen in future space projects is foreshadowed by a five-year contract recently signed between NASA and the Linde Company, a division of Union Carbide Corporation. One such project is the Centaur, consisting of a modified Atlas and a second-stage liquid oxygen/liquid hydrogen engine.

A $7 million contract to develop and build the high-energy second stage has been awarded to Convair Astronautics who are responsible for design, construction and testing of the vehicle and all its systems, except the engine. The latter is being developed by Pratt & Whitney under a separate ARDC contract announced in November, 1958.

In employing the Atlas as a booster, no basic changes will be required in the ICBM beyond a geometric alteration of the nose area to accommodate the upper stage. According to Mr. Roy W. Johnson, director of ARPA, use of this combination could orbit a satellite weighing several thousand pounds. A third stage is reported under development as an interplanetary probe.

Liquid hydrogen is also being used in the NASA/AEC Project Rover, a rocket vehicle which will have a nuclear reactor in one of its stages. Test facilities for the first experimental reactors in the programme were completed at the Atomic Energy Commission site in Nevada at the end of last year. Kiwi-A, a prototype ground-based installation, and subsequent Rover reactors will use solid fission fuel, movable moderator control rods and differ from conventional practice only in the use of gas cooling.

No direct application of this research in rockets is expected before the middle or late 1960's, though a design study is said to exist for a two-stage Rover vehicle capable of reaching Jupiter.

## Automatic Space-Navigator

THE enormous problems involved in obtaining a close-up photograph of another planet by contemporary methods of space-probing are outlined in a design-study currently being undertaken by the Massachusetts Institute of Technology.

The study surveys the prospects for sending a probe-borne camera on a reconnaissance flight around the Sun on a path which carries it within 5,000 miles of Mars. From this vantage point a single photograph would be taken which, if successful, would reveal intimate details of the planet and clear up once and for all the mysteries of its surface markings.

Four basic techniques are involved in planning an experiment of this kind: (a) propulsion; (b) guidance and navigation; (c) orientation, and (d) recovery.

Apart from controlling the speed and angle of departure within fine limits, provision must be made for course corrections along the transit path. An essential requirement would be a device for measuring the probe's relationship with the destination planet and bringing into play any necessary corrective manœuvres. Stellar navigation is suggested for this purpose, sightings being made of the Sun and two stars; orientation of the probe on three axes would be brought about by a system of electrically driven flywheels, with small rocket motors providing thrust to modify the flight path.

All control functions would be organized by an automatic "brain"—a miniaturized computer which most of the time would idle at low power, coming into full operation only when navigational information was required. The total weight of the guidance and control package is estimated at about 300 lb.

Assuming the mission is successfully accomplished, it remains to recover the camera. This could not be attempted until more than three years later when, with luck, the paths of Earth and probe vehicle will once more coincide. By this time, the probe would have twice circled the Sun.

Its successful recovery would depend on the accuracy of the guidance system, for the returning vehicle would have to come fairly close to the Earth to be appreciably influenced by its gravitational field, and would have to adjust its approach by means of rocket thrust. Presumably, it would then be relied on to make a ballistic re-entry into the atmosphere, unless methods have developed sufficiently for some bold astronaut to recover it from space.

The cost of obtaining a picture of Mars in this way would, of course, be quite fantastic if this were the sole objective. However, the main purpose of the experiment would be to prove the technique of automatic space-navigation, and the picture would represent the evidence of success.

# *Astronautics and Missile News in Brief*

Carried in the Russian Moon-probe Lunik, this spherical emblem would seem more appropriate to fragmentation on the Moon than orbiting the Sun.

**SATELLITE DIVIDENDS.** — Commenting on the rising cost of America's space-programmes—expected to exceed $485 millions in 1960—Mr. T. Keith Glennan, Director of NASA, said that satellites will be widely used in meteorology and in world-wide communications. The value of such advances "will be counted in billions of dollars."

**COLLABORATION.** — Proposals by the Canadian Defence Research Telecommunications Establishment "for continuing joint rocket and satellite ionospheric experiments" have been accepted by NASA, according to a joint announcement by NASA's Mr. T. Keith Glennan and Dr. A. H. Zimmerman, chairman of the Canadian Defence Research Board.

**PROJECT TIROS.**—Another NASA contract, this time amounting to $540,000 for infra-red and heat-balance apparatus in Project Tiros, a weather satellite, has been awarded to the U.S. Army Signal Corps.

**FLUORINE/HYDROGEN ENGINE.** —Feasibility studies for a high-energy fluorine/liquid hydrogen rocket engine—including the construction of "hardware"—are the subject of a $1,070,000 contract recently signed between NASA and Bell Aircraft Corporation.

# General Aviation News

**ROLLASON ACHIEVEMENT.**—In the past three years Rollason Aircraft and Engines, Ltd., of Croydon, have sold 72 aircraft, mostly rebuilt Tiger Moths, 33 of which have gone overseas. Eight Druine Turbulents have been built and sold; there have been 60 overhauls or conversions of club or private aircraft, and 115 engines have been overhauled or sold outright. The Ardem engine is being developed to increase its output. Among the many rebuilt Tiger Moths have been special versions for aerobatics, glider towing, parachute dropping and crop spraying.

**NEW PIAGGIOS.**—Two new versions of the Piaggio P.136-L amphibian are announced. They are the P.136L2-DK eight-seat amphibian, costing about £25,150, and the P.1361-L2 eight-seat flying-boat, priced at about £25,900. Both are available to special order by modifying standard production airframes. No prototypes are being built and the types will require no recertification.

**LOCKHEED CO-ORDINATION.**—The Lockheed Aircraft Corpn. has announced the formation of a new subsidiary—Lockheed Aircraft International—to co-ordinate its international operations and broaden the World market for its products.

the A.B.A.C. at 7c Lower Belgrave Street, London, S.W.1, for incorporatioin in the Association's recommendations.

**SYCAMORES GROUNDED.**—Following some recent accidents to Bristol Sycamore helicopters in Malaya, the type has been grounded by the R.A.F.

**NARDI PRODUCTION.**—An agreement has been reached between the Nardi and S.I.A.I. Marchetti concerns for 60 FN.333 four-seat amphibians to be built at Sesto Calende.

**PUNCTURE TROUBLE.**—An inflatable rubber aircraft—presumably a Goodyear—is reported to have crashed near Patuxent, Maryland, after one of the wing tips folded during a pull-out and fouled the propeller. The pilot baled out safely.

**YORKSHIRE CLUB.**—The new premises of the Yorkshire Aeroplane Club at Leeds/Bradford Airport were formally opened on April 25 by Ald. F. O'Donnell, chairman of the joint aerodrome committee. The chairman of the advisory committee, Mr. L. H. Riddell, presided, and was supported by Messrs. A. Barker and F. Leach, two directors of the club. Flying instruction is given by the Air Training Centre under Capt. A. Carvell.

BLUE STREAK PROPULSION.—This is the first photograph to be released of a Rolls-Royce rocket motor developed for the Blue Streak LRBM. The Rolls-Royce motor for Blue Streak is based on one produced originally by Rocketdyne. The 240,000-lb.-thrust Rocketdyne G-26 would appear to meet Blue Streak needs most closely. This was a two-chamber motor produced for the Navaho booster.

SPRAYMASTER.—In Crop Culture colours, this production Auster Workmaster, with the new Britten-Norman A.1000 rotary atomizers beneath its wings, was shown at Kidlington. A dorsal fin has been added since the prototype appeared.

*Photograph copyright "The Aeroplane and Astronautics"*

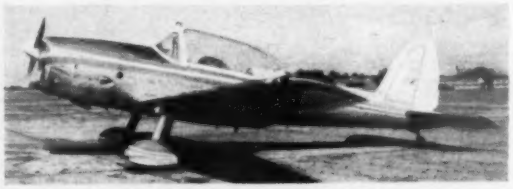
**BELL CONVERTIPLANE NEWS.**—The Bell XV-3 tilting-rotor convertiplane has now made 17 full conversions from vertical to level flight; the last three have been done above 10,000 ft. The rotor-cum-propellers have a two-speed gear to reduce rotational speed by 40% when they are used as propellers.

**AMENDING THE A.N.O.**—The Association of British Aero Clubs and Centres is considering recommendations to be made to the M.T.C.A. for amendments in the new Air Navigation Order and Air Navigation Regulations which are to replace those of 1954. Club members who have any suggestions about existing regulations are invited to send them to

**TURBOFAN DESIGNATION.**—U.S.A.F. has adopted a new series of designations, in the TF category, for turbofan engines. The Pratt & Whitney JT-3D, turbofan version of the J57 to be used in the Boeing B-52H bomber, is designated TF33.

**P. & W. NEWS.**—The Pratt & Whitney J58 single-spool turbojet, which is in the 30,000-lb. thrust class, has completed preliminary tests at the Florida Research and Development Centre. First deliveries of the JT-3D—turbofan version of the J57—are scheduled for mid-1960. The 3,000-lb. JT-12, weighing 430 lb., has completed preliminary flight tests at East Hartford. An afterburning version develops 3,900 lb. and weighs 645 lb. Design was started in July, 1957, and the first was successfully tested the following May. Development from initial design studies to the 50-hr. test took 13 months.

EXECUTIVE.—Modified by Mr. Peter Masefield, managing director of Bristol Aircraft, Ltd., this Chipmunk, G-AOTM, has a new bubble canopy, glass-fibre spats, spinner and front cowling, and a Grimes anti-collision beacon over the windscreen.



# Commercial Aviation Affairs

**THIRD FOR ARGENTINA.**—On Saturday morning, May 2, the third Aerolineas Argentinas Comet 4 left Hatfield for Buenos Aires flying via Frankfurt, Rome, Lisbon, Dakar, Recife and Rio and thus touching the points to be taken in by A.A. in its European services. B.O.A.C. has contracted to handle maintenance of A.A. Comets in London, Frankfurt, Rome and New York.

**NEW YORK NOISE.**—Port of New York Authority's aviation director, Mr. John Wylie, has complimented B.O.A.C., P.A.A. and National on their efforts to reduce noise disturbance by their jet aircraft operating at Idlewild. B.O.A.C. had the best record in six months of operation, having observed the regulations on 143 of 148 jet take-offs. Warning letters have been sent to American Airlines and T.W.A. for failing to take the proper measures to limit noise.

**HALF THE RISK.**—B.E.A., which has always carried 10% of its aircraft insurance and which increased this proportion to 33⅓% last year, has, from April 1 been carrying 50% of this flying risk. B.O.A.C. is now underwriting 15% of the risk of loss of certain propeller-type aircraft.

**SOUTH AMERICAN WAY.**—B.O.A.C. hopes to resume services to South America in the spring of 1960, using Comet 4s.

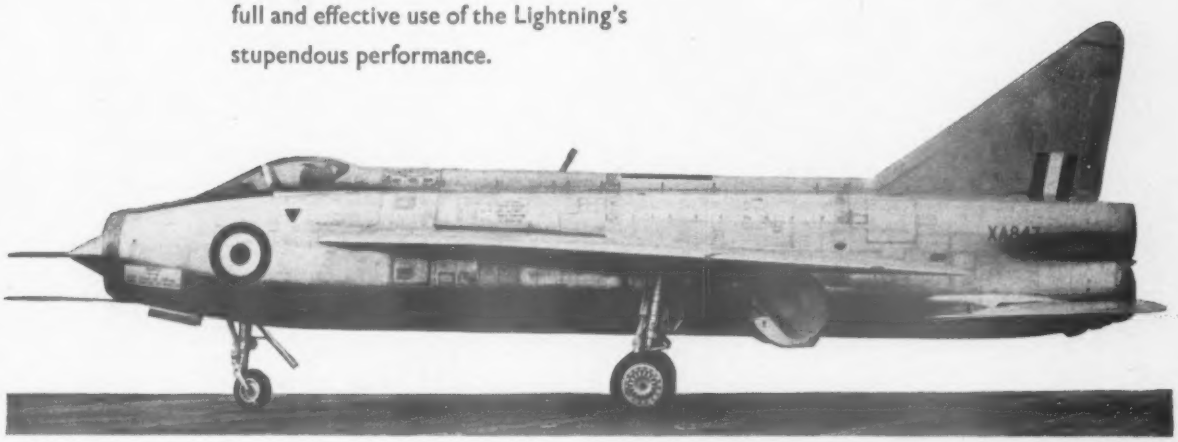
**RENFREW EXTENSION.**—Work has started on interim extensions to terminal facilities at Renfrew, to relieve congestion during traffic peaks during the summer.

**IRISH TRAFFIC.**—In the financial year ended March 31, 1959, Irish Air Lines carried 515,355 passengers and 9,077 tons of cargo. The transatlantic service carried 14,781 passengers.

(*Continued on page 557*)

# BY DAY OR NIGHT, IN ANY WEATHER...

The ENGLISH ELECTRIC Lightning provides front-line defence at all times. It is completely equipped with navigational, radar and automatic aids. Whatever the weather, in daylight or darkness, the pilot can make full and effective use of the Lightning's stupendous performance.



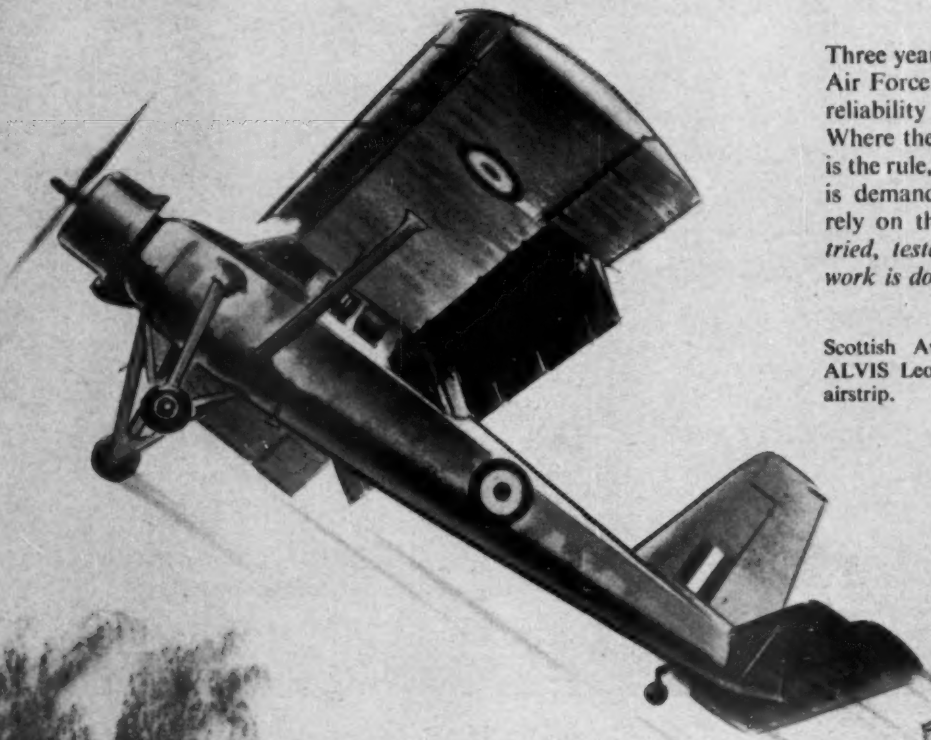
# ...THE LIGHTNING IS INCOMPARABLE

'ENGLISH ELECTRIC' aircraft

ENGLISH ELECTRIC AVIATION LIMITED · MARCONI HOUSE · STRAND · WC2

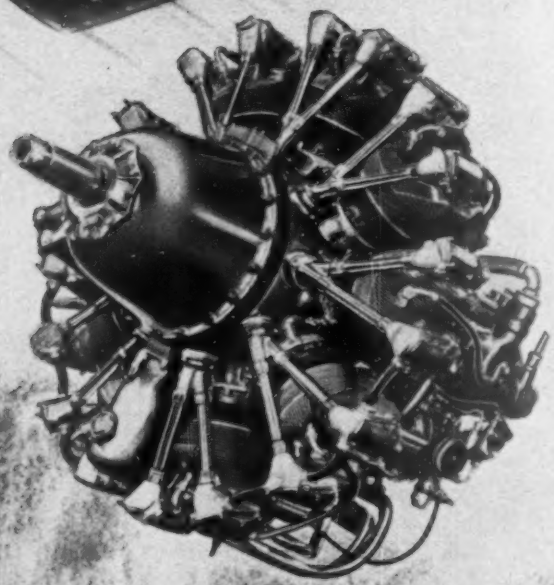
A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

# ACHIEVEMENT



Three years of service with the Royal Air Force in Malaya have proved the reliability of ALVIS aero engines. Where the minimum of maintenance is the rule, and the maximum of work is demanded, the Royal Air Force rely on the engines that have been *tried, tested, and proved where real work is done!*

Scottish Aviation Pioneer powered by ALVIS Leonides, taking off from jungle airstrip.



**ALVIS** **LEONIDES AERO ENGINES**

ALVIS LIMITED COVENTRY ENGLAND

(*Continued from page 556*)

**EXCHANGE NEWS.**—On a trial basis, the Aircraft Exchange has appointed representatives in Norway and in Chile to represent it on a basis similar to the IATA general agency arrangements for travel agents. The companies chosen are Air Service, Pilestredet 15, Oslo, Norway, and Sociedad General de Comercio, S.A., Casilla 904, Santiago, Chile. The head office of the exchange has been moved to Lincoln Building, 60 East 42nd Street, New York 17, New York.

**T.W.A. PROFIT.**—In the second half of 1958, T.W.A. recorded an operating profit of $10,196,000, compared with a loss of $1,305,000 in the same period of 1957. A detailed study and revisions of flight schedules coupled with expense control programmes are given as reasons for the improvement. In the whole of 1958, an operating loss of $375,000 occurred, compared with a loss of $4,539,000 in 1957. Gross revenue improved by 8%, of which 3% was attributed to increased fares.

**IATA FIELD MISSION.**—Traffic control specialists are visiting about 20 airports in the Middle and Far East this month and next, as part of an IATA mission to help local airport authorities plan the introduction of jet aircraft.

**BRISBANE RUNWAY.**—An 8,000-ft. runway and a new control tower have been put into use at Brisbane, in preparation for the Qantas 707 service later this year.

IN NEW GUISE.—Aircraft of the Independent Air Travel fleet are now reappearing in the livery of Falcon Airways, Ltd., a private company formed on December 3, 1958, to take over the former's assets.

**JAPANESE HELICOPTER PLAN.**—Japan Air Lines is planning to purchase a large helicopter for experimental use, with the Ministry of Transportation's support. Choice of equipment will be made between such types as the Fairey Rotodyne, Vertol 107 and Sikorsky S-61.

**TRANS - PACIFIC CARGO.**—On May 2 Japan Air Lines began a weekly trans-Pacific cargo service, using a DC-4, connecting Tokyo and San Francisco. For the first three months, the service is operated by Transocean Airlines under charter to J.A.L.

**ELECTRA LOADS.**—In the first few months of operation, Electras of American Airlines have had average load factors of nearly 80%, compared with 65.6% for the company's fleet in 1958.

**BRUSSELS HELIPORT.**—A new helistation has been built at the Allée Verte in Brussels for the use of passengers on the Sabena helicopter services. It comprises a building approximately 100 ft. by 65 ft., with a covered jetty 200 ft. long at one end. This embarkation jetty contains passenger waiting-rooms, and general passenger facilities are contained in the main hall. Provision has been made for 12 arrivals and 12 departures per hour, or a maximum of 150 passengers in each direction.

**JET STARTERS.**—Northwest Airlines has ordered 16 Boeing Turbo-Starters for use with its fleet of DC-8s and Electras.

**TUDOR FOUND.**—The wreckage of the Air Charter Super Trader (Tudor) which was missing between Ankara and Bahrein, was located on April 29 near the top of Suphan Dag, a 14,000 ft. peak on the northern shore of Lake Van. An R.A.F. rescue team which succeeded in reaching the site found no survivors.

**SPANISH LOSS.**—A DC-3 of Iberia, the Spanish airline, crashed in the mountains near Valdemeca, 150 miles east of Madrid, on April 29. All 28 occupants were killed.

## *News About People*

**FAIREY DIRECTOR.**—Mr. Godfrey C. D'Arcy Bliss has been appointed an additional director of the Fairey Co., Ltd. He is a senior partner of Ashurst, Morris, Crisp and Co., Fairey's solicitors since 1915.

**VICKERS POSTS.**—Mr. A. N. Clifton (below) and Mr. Maurice J. Brennan have been appointed assistant chief engineers

TO WEYBRIDGE.—Mr. A. N. Clifton has been appointed an assistant chief engineer at Vickers-Armstrongs (Aircraft), Ltd.

of Vickers-Armstrongs (Aircraft), Ltd. Mr. Clifton was formerly chief designer (aircraft) at Supermarine and now moves to Weybridge in accordance with the new centralization policy. Mr. Brennan was fomerly chief designer of Saunders-Roe, Ltd.

**MITCHELL AWARD.**—Mr. James H. Kindelberger, chairman of North American Aviation, Inc., and a governor of the Aircraft Industries Association, is to receive the William E. Mitchell Award for outstanding contribution to aviation progress.

**GLOSTER BOARD CHANGES.**—As part of the general reorganization taking place within Hawker Siddeley Aviation, Ltd., changes have been made to the Gloster Aircraft board. H. H. Burroughes becomes chairman, E. W. Shambrook general manager and H. W. Sidwell works director. J. A. R. Kay, J. T. Lidbury and S. D. Davies join the board, with Sir Roy Dobson, Sir Thomas Sopwith and R. W. Walker. R. V. Atkinson has retired.

F.A.A. PROMOTION.—Vice-Admiral Sir Walter T. Couchman, K.C.B., C.V.O., D.S.O., O.B.E., Flag Officer Air (Home), has been promoted to the rank of Admiral.

**IRISH PUBLICITY.**—Mr. T. P. Byrne has been appointed publicity manager for Irish Air Lines, with effect from June 1. He succeeds Mr. G. C. Draper, who, as already announced is joining Central African Airways. Prior to his new appointment, Mr. Byrne was the company's services manager; he has been with Irish Air Lines for 13 years.

END OF "THUM."—On May 1 the last daily "temperature-humidity" met. flight by Shorts was made from Woodvale, Lancs. In the past eight years some 2,800 sorties have been flown. In this picture the crew, J. Formby and E. A. Richards, hand over the last chart to Dr. J. M. Stagg, director of services. Also seen are Gp. Capt. H. R. Edge, S.O.A., No. 12 Fighter Group, and F. A. Chapman.

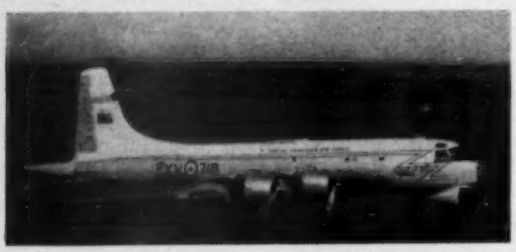
TO HAMBLE. — Air Marshal Sir Richard Atcherley has been appointed sales director of Folland Aircraft, Ltd., as from May 1, with responsibility for all aspects of sales promotion.

**AIR POST.** — Air Vice-Marshal L. W. C. Bower, C.B., D.S.O., D.F.C., has been appointed A.O.C., No. 19 Group, Coastal Command, R.A.F.

**TRANSISTOR POST.**—Mr. C. H. Noton, M.Sc., Ph.D., F.Inst.F., M.S.M.A., has been appointed commercial manager of Semiconductors, Ltd.

**ELLIOTT BOARD.**—Mr. R. S. Hewitt has joined the board of Elliott Brothers (London), Ltd. He started his career with Elliott Brothers in 1928 and is deputy controller of Elliott-Automation.

# Military Aviation Affairs



R.C.A.F. BIRTHDAY.—This year the Royal Canadian Air Force celebrates its 35th birthday. Formed on April 1, 1924, the service to-day has 40 regular and auxiliary squadrons, two of which are equipped with the Canadair Argus anti-submarine aircraft seen here.

**COMMEMORATION SERVICE.**—The sixth annual Commemoration Service at the Commonwealth Air Forces Runnymede Memorial on Coopers Hill, Egham, will take place on May 12 at 15.15 hrs. This year the first wreath will be laid by India and the religious ceremony will be conducted by the Chaplain-in-Chief of the R.A.F., the Ven. F. W. Cocks.

**F.E.A.F. BEVERLEYS.** — The first Beverley transport to operate in the Far East has recently completed its local familiarization flight trials from R.A.F. Changi before these aircraft go into general F.E.A.F. squadron service. Further Beverleys are expected to arrive in Singapore at the rate of one a month.

**WEAPONS TRIALS.**—H.M.S. "Girdle Ness," which has undertaken firings and extensive tests of the Seaslug SAM, was recommissioned at Devonport on April 28 for a new series of tests while based on Malta.

**LISBON FAIR.** — The carrier "Centaur" is to visit Lisbon between May 28 and June 4 in support of the British Overseas Trade Fair. During the visit, Sea Hawks and Sea Venoms from the carrier will provide a flying display.

# Soaring Round the Regulations

CROSS-COUNTRY soaring, as an art, looks like being just a passing phase in the history of mankind, sandwiched between an infinite past in which it was impossible because of technological ignorance, and an interminable future in which it will be made equally impossible by airspace restrictions. One glance at an Airways chart suggests that we in Great Britain may have already passed the half-way mark, and the adjoining map shows the effects of a further stage in restrictive legislation, first introduced by Notam 482/1957 which amended Rule 44, Schedule 2 of the Air Navigation Order 1954.

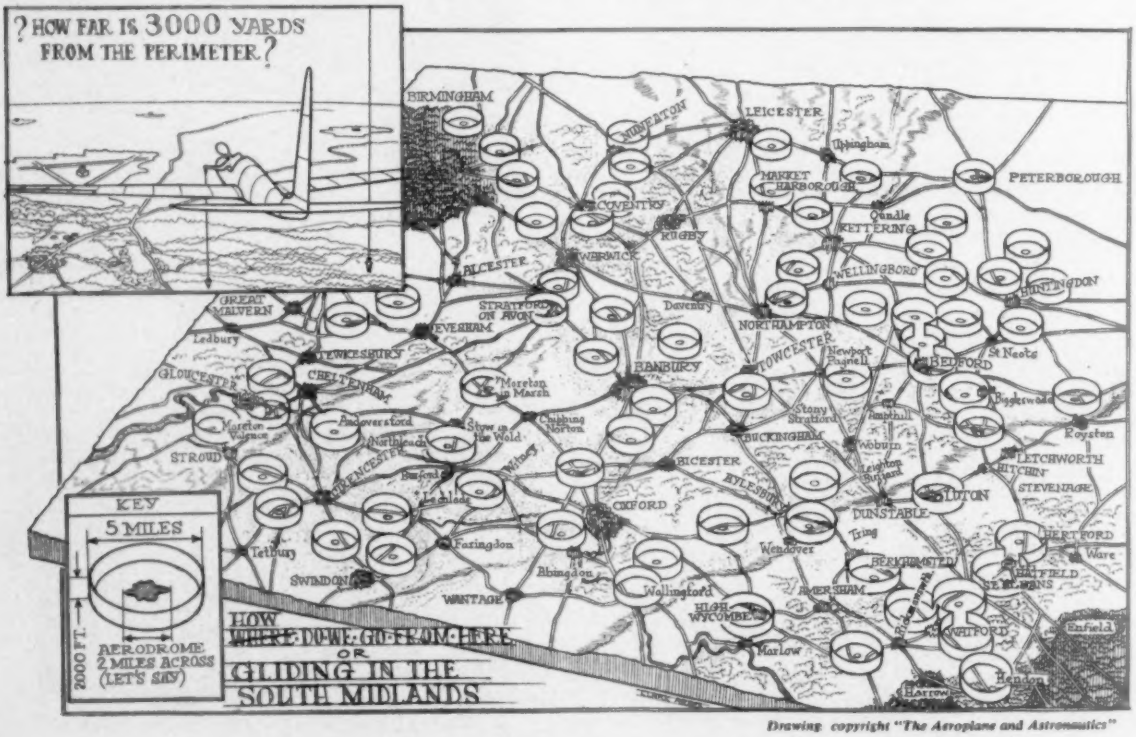
This states that no aircraft shall enter the "traffic zone" of any aerodrome except for the purpose of landing, and the "traffic zone" means 2,000 ft. vertically upwards from a ground area which not only includes the aerodrome but extends 3,000 yards outwards from its perimeter on all sides. As soon as this new regulation appeared, the British Gliding Association naturally got busy, and complained via the Aviation Committee of the Royal Aero Club to the Ministry of Transport and Civil Aviation, which, on hearing that gliding people could not possibly conform to it, agreed in principle to a B.G.A. suggestion that it should apply only to certain active airfields.

The Ministry promised to consider producing a list of airfields to which the regulation would not apply, but is still apparently at the considering stage.

Here is a map of the South Midlands which includes the sites of five active gliding clubs: London, Bristol, Coventry, Oxford and Northampton, while Lasham and Cambridge are just outside it, and most flights of any consequence from the Midland Club, and many from the Derbyshire and Lancashire Club, are also bound to cross part of the area shown.

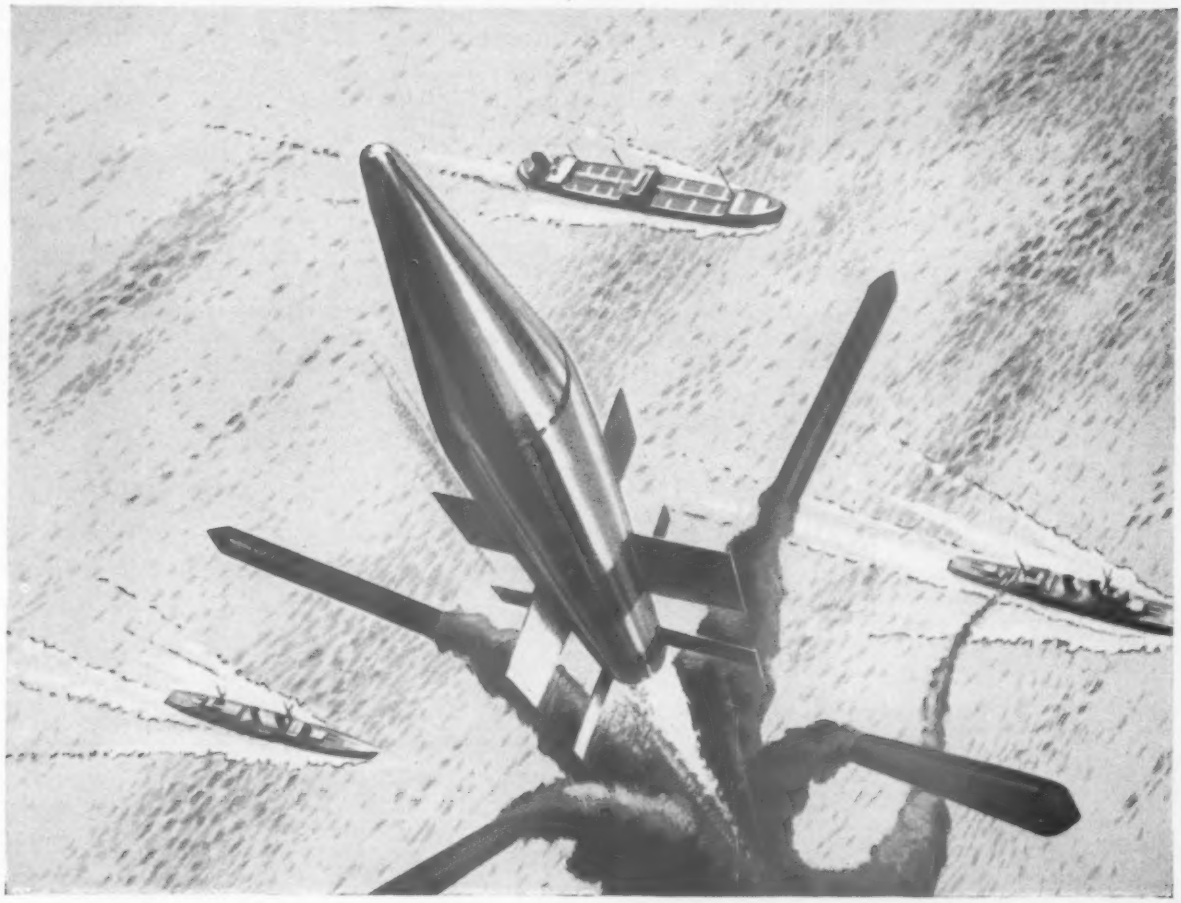
Take a look, for instance, at the 40-mile stretch from Peterborough to Hitchin: how, on an east-west course or v.ce versa do you thread your way through the maze while keeping a close enough watch on your variometer to be able to stay up at all? The answer, presumably, is that your almost inev.table descent will be "for the purpose of landing" and so will be legal.

In fact, considering Lorne Welch's recent advice that you should never sink below 2,000 ft. without having a landing field within reach, you may well be technically on the way to a landing every time you subside into an aerodrome traffic zone. If, on the way down, you blunder into another thermal and get carried up again, willy-nilly, it's just too bad—at least from the point of view of the regulation.—A.E.S.




*Drawing copyright "The Aeroplane and Astronautics"*

# SEASLUG



## SHIP-TO-AIR MISSILE WITH A SHARPSHOOTING RECORD

The Seaslug is the Royal Navy's first ship-to-air missile. Launched from the pitching, tossing deck of its trial ship, H.M.S. Girdle Ness, it has proved its accuracy under the most trying conditions. Although the Seaslug does not need to score a hit to destroy its target, the test vehicle, without a warhead, has made direct strikes frequently on target aircraft. With long range radar, it can engage bombers up to the maximum height at which modern aircraft can fly. The firing crew is far smaller than the crew of a gun turret in a major warship.

Powered by a solid fuel sustainer motor and four boosts, the Seaslug has been designed and constructed by AWA in conjunction with the Sperry Gyroscope Co. Ltd., and G.E.C. Ltd.

**SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,** Baginton, Coventry, England

MEMBER OF HAWKER SIDDELEY AVIATION DIVISION

## NEWEST MEMBER IN A FAMILY OF GREATS

The Canadair-Convair '540', by the application of turbine power, becomes the ultimate development of the widely used and approved Convair 240-340-440 series. The '540' is now on order and in full scale production, and is currently being demonstrated to airlines and business aircraft owners throughout North America.

# 6 MAJOR REASONS

# why the '540' is the new challenger on short-to-medium routes!

## 1 DEFINITELY LOWER OPERATING COSTS

The standard 48-seat Canadair-Convair '540' offers **a direct operating cost of 1.4¢ per seat mile which comes down to 1.1¢ in the 58-seat configuration.** Over distances as short as 80 miles, its economy of operation matches even that of piston-engined aircraft.

## 2 GROWTH CAPACITY TO MEET GROWING ROUTE DENSITIES

The Canadair-Convair '540' has the built-in capability of growing with the increased traffic densities that are forecast for the years ahead. It can do this because its **seating capacity can be increased by 20% from 48 to 58 without weight or operating penalty.** All fuel for terminal-to-terminal operation could still be carried.

## 3 MATCHED-TO-TASK JET-PROP ENGINES

The Napier 3500 e.h.p. engines that power the Canadair-Convair '540' are **the only jet-props specifically designed for the particularly strenuous up-and-down life of short stage operations.** The sectionalized design of these powerful new engines make them singularly easy to service and maintain.

## 4 REDUCED EN-ROUTE GROUND TIME LOSSES

The Canadair-Convair '540' **eliminates numerous possible time delays at en-route stops:** passenger handling is expedited . . . time consuming engine warm-ups are unnecessary . . . as many as 6 route stops can be made without refuelling.

## 5 FASTER FLYING, QUICKER CLIMBING

Today's passengers want to **make time.** The Canadair-Convair '540' is **the fastest aircraft in its class,** flying at speeds up to 340 m.p.h. It's off the ground in a flash and takes only 6.4 minutes to climb to an operating level of 10,000 feet.

## 6 EXTRA CARGO SPACE FOR EXTRA PROFITS

The Canadair-Convair '540' has 402 cubic feet of easily accessible cargo space: enough for **two tons of additional payload** that can be carried with no operating penalty.

**MOST IMPORTANT TO YOU:** the Canadair-Convair '540' is a product of the combined experience and facilities of two of the world's great aircraft producers—Canadair Limited of Canada and Convair—both members of the General Dynamics family of companies.

### THE CANADAIR-CONVAIR '540' WILL SOON TOUR WESTERN EUROPE

For full information about the new aircraft or the tour, please contact our European Representative, J. H. Davis, Princes House, 190 Piccadilly, London, W. 1, England.

# CANADAIR CONVAIR 540

## JET-PROP AIRLINER

**CANADAIR,** MONTREAL, CANADA

THE CANADIAN SUBSIDIARY OF GENERAL DYNAMICS CORPORATION CA59-540-22UKT

# Marconi in the Comet 4

**Equipped by Marconi to meet the major radio requirements of a modern airliner**

# MARCONI

**COMPLETE AIRCRAFT AND AIRPORT RADIO SYSTEMS**

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

M.2A

# Correspondence

## Postscript to a 707 Incident

THE article headed "A Boeing Incident Explained" in THE AEROPLANE for April 17, calls for comment especially where it attempts to draw a comparison between the flying characteristics of the Boeing 707 transport and the Boeing B-47 bomber.

Briefly, the B-47 aeroplane does not have the same basic wing as the 707, contrary to what your article states. Both wings have 35° sweepback and both were designed and built by Boeing, and there the similarity ends. The wings have different aspect ratios, different airfoil sections, and different thickness ratios.

The most important difference, and one that would prevent the 707 from having the same behaviour pattern as the B-47, is that the B-47 wing had a constant wing-thickness-to-chord ratio across the wing, while the 707 has a relatively high thickness-to-chord ratio at the root and a relatively low thickness ratio at the wing tip. The 707 thickness ratio not only varies with span, but the % chord for maximum thickness is varied along the wing span by changing the airfoil sections. At least three different airfoil sections are used.

It should be emphasized that the 707 does not have "coffin corner" characteristics. In the 707 incident of February 3, the aeroplane was cruising at Mach .82 at 35,000 ft. and the change in trim resulting from a speed increase is easily controllable. The aeroplane at cruise was far away from any low speed stall.

In the B-47 accident mentioned in your article the aeroplane did actually become uncontrollable since, among other things, it greatly exceeded the speeds at which the B-47 ailerons become ineffective or actually reverse. In the case of the 707 accident the aeroplane, even though it went too far into a diving turn, was still controllable, as evidenced by the recovery made.

Geneva, Switzerland. PERCY A. BLACKBURN,
European Public Relations Representative,
Boeing Airplane Company.

## Type-hunters' Corner

CAPT. YOUELL'S record of 110 types flown between 1917 and 1959 (see last week's issue) is a fairly good one, but it has been handsomely beaten by those of a number of pilots who have enjoyed special opportunities in their flying lives.

Even as an amateur who turned pseudo-professional for the six years of war I can claim a total of 102 essentially different types for the period 1929-1950 and if every mark of aircraft were to be counted the figure would be 150 or so. This relatively modest score of civil and military aeroplanes is enlivened by oddities such as the pusher-tricycle Scheldemusch, a Curtiss Cleveland dive-bomber and the Airacobra—with its Allison engine in the small of the pilot's back and a propeller shaft running noisily between his legs.

Thinking of those days one tends to forget the test-flight struggles with monstrous devices like the Fortress and the Liberator and to remember with pleasure the early marks of Spitfire and Hurricane, the Gladiators—and one old Gauntlet click-clacking along with me over a sunny English countryside in which nearly every field was a prospective aerodrome.

London, S.W.3. H. A. TAYLOR.

## Nigerian Airways Report

IT seems a pity that your contributor, Mr. R. Bensted-Smith, did not take the trouble to check some of his facts properly in connection with his "African Vignette," see page 371 of your March 27 issue.

His statement, "The fleet at present consists of seven DC-3s and six D.H. Herons—both incidentally with an excellent safety record, the only fatal accident in 11 years of operations occurring on a service flight with a Heron two years ago," is not only inaccurate but misleading, to say the least!

In the first place, in its 11 years of operations WAAC-Nigerian Airways has suffered four fatal accidents although it's only fair to point out that in only two of these (the Wayfarer crash in February, 1955, and a Dove accident in May, 1949) was there loss of lives involving passengers. The other accidents, one by a Heron and the other by a Dove, involved crews only as both flights were "non-revenue," and no fare-paying passengers were killed.

Secondly the author might have taken the trouble to point out that the seven DC-3s were not acquired until 1957 whereas a total of eight Herons were delivered in late 1955 and early 1956. It was a direct result of the airline chartering four DC-3s during 1955 that finally convinced them of the excellent suitability of this type to be used in conjunction with their Heron fleet which was bought to replace the Doves, Marathons, and even the Wayfarers.

Nairobi, Kenya. DENNIS M. POWELL.

["African Vignette" may have credited WAAC-Nigeria with a better safety record of passenger flying than in fact it can claim, but our correspondent is not altogether fair to the author in his second point, as the article did not set out to be a history of the company, but was, rather, a glimpse of operations today.—ED.]

## Groundabout

**Price of Progress.** This column recently quoted: "I'm against all change, even if it's an improvement." The Editor sees some connection with reactions to the new look at the front of this magazine. After the first issue had appeared, one caller said "I suppose it's because of the current printing difficulty that you have a blank first editorial page and no leader?"

*

**Hole Truth.** At the first demonstration of Sikorsky's S-60 Flying Crane, it placed a 2-ton pole in a "pre-dug" hole. This sort of old-fashioned hole is expected to be replaced by the new, prefabricated, mobile UH-90A Great Godown titanium utility hole now being developed by the Consolidated Cavity Corpn., Inc., under a $75 million U.S.A.F. contract.

*

**Luck and Mr. Humphery.** The piece here about airlines' alleged superstitious practices has recalled to Geoffrey Dorman that 'way back, somebody statistically proved that every 26th flight had engine trouble and every 39th had weather trouble. George Woods-Humphrey, then Daimler Airway's general manager, commented that obviously the only way to get 100% regularity would be to cancel every 26th and 39th flight. This sounds vaguely like the cure for that "Monday morning" feeling—start work on Tuesday.

*

**Transitory to Orbitory.** American uninhibition (if there is no such word, there is now, *and* coined by an Englishman) in the coining of words is delightfully demonstrated in a speech by Dr. R. A. Cornog, head of the sonorously titled Space Physics Group, Astro - Vehicles Laboratory, Space Technology Laboratories, Inc., Cal. All this profundity doesn't stop the doctor from saying: ". . . it would be handy-dandy to have a population capable of long periods of hibernation available to populate an inter-stellar vehicle. It would also be most helpful if the average lifetime were, say, 500 years, rather than our present transitory existence."

*

**What, no Irishman?** The Pathfinder's magazine *The Marker*, records that when their Hon. Sec., that braw Scot Hamish Mahaddie, received a "Special Air Freight" parcel at his office, it looked so impressive that he paid the 19s. "delivery fee" without a murmur, and eagerly opened the parcel.

Anybody want 2,000 leaflets on Holidays in Israel?

*

**Traditional**

**Crew-Room Definition of the R.A.F.:** "A self-adjusting shambles."

**R.A.F. Engineer Officer's First Law of Aircraft Constructors:** "If it is necessary to install any adjustable component in an aircraft, such cannot be considered to be satisfactorily located unless it can be touched with one finger outstretched or seen with one eye, but never simultaneously."

**Airline Executive:** "Everything would be fine if only we didn't have aeroplanes."

by Argus

# NOTES AND EVENTS

**MATERIALS HANDLING.** — The National Joint Committee on Materials Handling is available to assist secretaries of societies and other bodies in drawing up their programmes for 1959-60 by suggesting suitable subjects for lectures and possible lecturers. Further information can be obtained from the committee at 69 Cannon Street, London, E.C.4 (Phone, City 4444).

**TEST EQUIPMENT.**—The Solartron Electronic Group, Ltd., has concluded with the Svenska Flygmotor Aktiebolaget a manufacturing and marketing agreement for a new "vibrating-cylinder" pressure transducer, which is claimed to be unique. Production has already begun in Britain and the transducer has M.o.S. approval for incorporation into missiles and other equipment during test.

**NEW DEPARTMENT.** — Electro-Hydraulics, Ltd., recently announced the establishment of a new industrial hydraulic sales department under the direction of Mr. L. Rumley (sales director of Electro-Hydraulic, Ltd., and Conveyancer Fork Trucks, Ltd.). Electro-Hydraulics, Ltd., has long been established as a manufacturer of hydraulic equipment for aircraft and of fork-lift trucks.

**TRANSISTOR SHOW.**—Promoted by the Electronics and Communications Section of the Institution of Electrical Engineers, an International Transistor Convention and Exhibition is to be held at Earls Court, London, between May 21 and 27. Part of the exhibition will be devoted to transistor research and development.

**NON-FERROUS METALS.**—W. Wilson and Sons (London), Ltd., 114 Nightingale Road, London, N.22, approved stockholders of non-ferrous metals for the aircraft industry, has recently enlarged its premises and opened an additional warehouse. With its two associates, Wilson Alloys, Ltd., and Sheringham Metals, Ltd., the company operates a comprehensive supply service in non-ferrous metals which is approved by A.I.D. and A.R.B.

**HANOVER SHOW.**—As part of its policy of pursuing World markets, Rotol, Ltd., showed a representative range of its products at the recent Aircraft Exhibition in Hanover (April 27-May 5). Mr. H. Hewport, Rotol sales manager, represented the company.

**SPANISH ORDER.** — Heenan and Froude, Ltd., of Worcester, is to supply a special motoring/absorbing dynamometer to the Instituto Nacional de Technia Aeronautica, of Madrid. The dynamometer, which will consist of two units in tandem, one a Heenan Dynamatic eddy current dynamometer and the other a DC motor, will be used to test internal-combustion engines.

**PLESSEY EXPANSION.**—The formation of a German company to further Plessey interests in the European market is announced by Plessey International,

AIRCRAFT JIGS.—This quickly constructed jig for building light aircraft was made of Dexion slotted angle by Establishment R. Renard, Angers, France. The jig, which can be expanded at intervals up to 5 ft., is being used for the construction of Piel Emeraude ultra-light aircraft.

Ltd. Registered as Plessey Maschinen Elemente Gesellschaft m.b.H., the new company will be responsible for the manufacture of many products in the light engineering field, and production will be at Neuss, near Düsseldorf.

## Company Notices

### NEW COMPANIES

**Contracting and Surfacing, Ltd.** (625,880).—Private co. Reg. April 15. Cap. £5,000 in £1 shs. Objects: To carry on the business of builders and constructors of roads, aerodromes, landing fields, houses, shops, etc. Subscribers (each with one sh.): Leslie E. Watts, 11 Cherry Walk, Hayes, Kent, accountant; Bernard E. Calman, 29 Downs Avenue, Chislehurst, accountant. Percy J. D. H. Norton, of Priors House, King St., West Malling, Kent (director of South Eastern Engineering Co., Ltd., etc.), is first director. Sec.: L. E. Watts. Reg. off.: Priors House, King St., West Malling, Kent.

**Cumberland Aviation Services, Ltd.** (625,586).—Private co. Reg. April 9. Cap. £8,000 in 12,000 founders' shs. of 5s. and 5,000 ord. shs. of £1 each. Objects: To carry on the business of operators of aeroplanes, helicopters and other aircraft, providers of maintenance and servicing of aircraft, etc. Subscribers (each with one founder sh.): John M. Kidd, civil aviation executive, and Mrs. Patricia L. Kidd, both of Thackwood, Penrith, Cumberland. John M. Kidd is permanent director. Solrs.: Walter Burgis and Co., 7-9 St. James's St., London, S.W.1.

**Yorkshire Flying Services, Ltd.** (625,832).—Private co. Reg. April 14. Cap. £1,000 in £1 shs. Objects: To carry on the business of aviation instructors, buyers and sellers and hirers of aircraft and contractors for aerial work of all kinds, etc. Directors: Arthur R. Carvell, 2 Wood View, Thompson Lane, Baildon Green, York; Samuel O. Whiteley, Slitheroe Bridge, Rishworth, nr. Halifax, director of Whiteley (Rishworth), Ltd. etc. Sec.: Arthur R. Carvell. Solr.: W. B. D. Shackleton, Bradford, 1. Reg. off.: The Airfield, Yeadon, nr. Leeds.

### OVERSEAS COMPANIES

**Aircraft Exchange, Inc.** (F.4,787).—Particulars filed April 16, 1959, pursuant to Section 407 of the Companies Act 1948. Cap.: Stock $100,000 in 600 6% cumulative preferred stock of par value of $100 per sh., and 4,000 shs. of common stock of $10 per sh. Reg. in State of New York, U.S.A., in April, 1958, to carry on a market for the sale or lease of aircraft, etc. British address: 46 (19) Upper Grosvenor St., London, W.1, where Dennis Handover is authorized to accept service of process and notices. Directors: Charles Brondi, Herbert B. Dorau, Robert I. Hellieson, Ralph V. Hudnut, Edward A. Merkle, Alfred C. Turino and Norton Wolovsky, all resident in U.S.A.

**Nigerian National Line, Ltd.** (4,788).—Particulars filed April 16, 1959, pursuant to Section 407 of the Companies Act 1948. Cap.: £2,000,000 in £1 shs. (400,000 founders); 120,000 of the founders' shs. shall be termed Founders "B" shares and issued to Elder Dempster Lines, Ltd., and 76,000 founders' shs. shall be termed Founders "C" shares and issued to Palm Line, Ltd. Reg. in Nigeria on Feb. 5, 1959, to establish, maintain and operate shipping, air transport and road transport services, etc. British address: Dunster House, 37 Mincing Lane, London, E.C.3, where Donald H. Tod is authorized to accept service of process and notices. Directors: Louis P. Ojukwu, Ikoye, Lagos; Luscaka K. Anja, Gboko via Makurdi; Joseph B. Daramola, Lagos; Albert E. Hoffman, 39 Draycott Ave., Kenton, Harrow; John H. Joyce, 8 Talbot Rd., Birkenhead, and Albert E. Muirhead, "Farthings," Rivacre Rd., Hooton, Ches.

### CHANGE OF NAME

**Brush Traction, Ltd.** (401,466), Dukes Court, Duke St., London, S.W.1. Name changed to Hawker Siddeley Brush Turbines, Ltd., on Feb. 2, 1959.

## Aviation Calendar

**May 8-10.**—Channel Islands international air rally at **Jersey Airport.**

**May 9.**—U.S.A.F. "At Home," at R.A.F. **Weatherfield,** Essex.

**May 9-10.**—British Women Pilots' Association flying week-end, at **Snoring Aerodrome,** Fakenham, Norfolk.

**May 9-10.**—National Glider Trade Fair, at **Lasham Gliding Centre,** near Alton, Hants.

**May 9-18.**—National Gliding Championships, at **Lasham Gliding Centre,** near Alton, Hants.

**May 10.**—International helicopter rally, at **Woburn Abbey,** Beds.

**May 11.**—R.Ae.S. Halton Branch lecture, "Some Aspects of Nuclear Propulsion," by Sqn. Ldr. G. R. Candy, at the Branch H.Q., R.A.F. **Halton,** at 18.45 hrs.

**May 11.**—R.Ae.S. Glasgow Branch lecture, "Philosophy of Gas Turbine Design," by D. L. Brown, at the R. College of Science and Technology, **Glasgow,** at 19.15 hrs.

**May 13.**—R.Ae.S. Chester Branch A.G.M. and film show, in the lecture theatre, Grosvenor Museum, **Chester,** at 19.30 hrs.

**May 13.**—R.Ae.S. Southend Branch lecture, "Space Travel," by Dr. G. S. Brosan, at the Labour Hall, Boston Avenue, **Southend,** at 19.30 hrs.

**May 14.**—R.Ae.S. 47th Wilbur Wright Memorial Lecture, by C. J. McCarthy, at the Inst. of Mech. Engineers, Birdcage Walk, **London,** S.W.1, at 18.00 hrs.

**May 16-31.**—National Gliding Championships organized by Austrian Ae.C., at Zell am See, near **Salzburg,** Austria.

**May 17-18.**—Whitsun Week-end organized by Auto-Sport, Ltd., at **Ramsgate Airport,** Kent.

**May 17-19.**—International aeroplane sales fair, at **Cosne sur Loire,** Nièvre, France.

**May 18.**—R.A.F.A. (Eastern Area) air display, at **Hucknall aerodrome,** Notts.

**May 18-29.**—University of Rome/AGARD lectures, "Astronautics and Space Sciences," in **Rome.**

**May 21.**—Women's Engineering Society London Branch lecture, "Aerial Survey Methods," at Hope House, 45 Great Peter Street, **London,** S.W.1, at 19.00 hrs.

**May 23-25.**—Fifth air touring rally organized by Quiberon Ae.C., at **Quiberon,** France.

**May 25-June 2.**—F.A.I. annual conference, in **Moscow.**

## Personal Notices

### BIRTHS

**Brettell.**—On April 23, at Stamford Hospital, to Anne, wife of Flt. Lt. Ian Brettell—a son.

**Brown.**—On April 26, at Louth Hospital, to Peta, wife of Flt. Lt. Robin Brown—a daughter.

**Darlington.**—On April 20, at Fulford Hospital, York, to Jeane Blanche, wife of Flt. Lt. F. W. H. Darlington, A.F.C., R.A.F.—a son.

**Davidson.**—On April 26, to Patricia, wife of Flg. Off. Roland H. Davidson, R.A.F.—a daughter.

**Jennings.**—On April 23, at B.M.H. Hanover, to Mildred, wife of Flt. Lt. D. R. Jennings, R.A.F.—a daughter.

**Law.**—On April 25, at Tidworth Military Hospital, to Patricia, wife of Flt. Lt. R. N. Law, R.A.A.F.—a daughter.

**Lunn.**—On April 26, at R.A.F. Hospital, Nocton Hall, to Diana, wife of Flt. Lt. L. C. Lunn—a son.

**Mackenzie.**—On April 18, at Christchurch, New Zealand, to Jean, wife of Wg. Cdr. R. M. Mackenzie, D.S.O., D.F.C., A.F.C., R.A.F. (retd.)—a daughter.

**Rowe.**—On April 25, at Newark, to Sheila Jane, wife of Flt. Lt. David Rowe—a son.

### DEATHS

**St. John.**—On April 26, Wg. Cdr. John Ramsey St. John, D.S.O., D.F.C.

**Thomas.**—On April 21, at Midhurst, Wg. Cdr. Eric Hugh Thomas, D.S.O., D.F.C.

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Fig. 2

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These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 488-1


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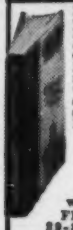

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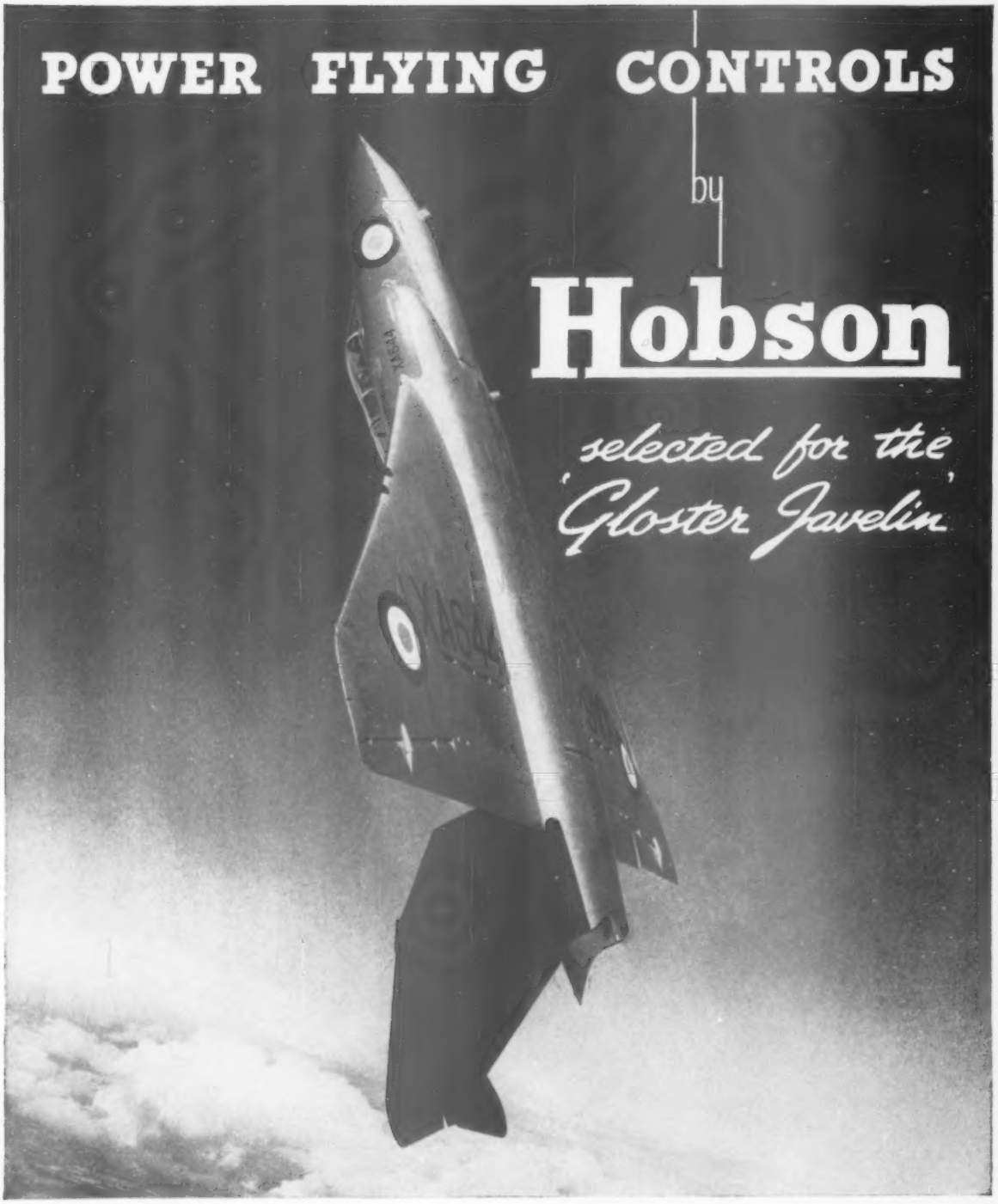

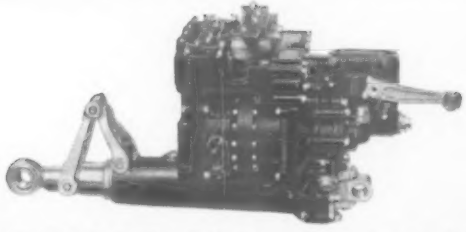

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